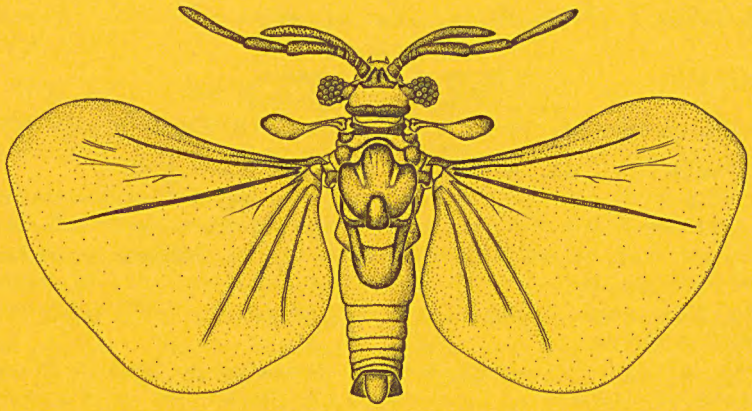
THE AUSTRALIAN
Entomologist

published by

THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND



Volume 24, Part 1, 25 July 1997
Price: $5.00 per part

Published by: THE ENTOMOLOGICAL SOCIETY OF QUEENSLAND
ISSN 1320 6133

THE AUSTRALIAN ENTOMOLOGIST

The Australian Entomologist (formerly *Australian Entomological Magazine*) is a non-profit journal published in four parts annually by the Entomological Society of Queensland. It is devoted to entomology of the Australian region, including New Zealand, Papua New Guinea and islands of the south-western Pacific. Articles are accepted from amateur and professional entomologists. The journal is produced independently and subscription to the journal is not included with membership of the Society.

Subscriptions

Subscriptions are payable in advance to the Business Manager, The Australian Entomologist, P.O. Box 537, Indooroopilly, Qld, Australia, 4068.

For individuals	A$16.00 per annum Australia
	A$20.00 per annum elsewhere
For institutions	A$20.00 per annum Australia.
	A$22.00 per annum elsewhere.

Cheques in currency other than Australian dollars should include an extra A$5.00.

ENTOMOLOGICAL SOCIETY OF QUEENSLAND

Membership is open to anyone interested in Entomology. Meetings are normally held in the Department of Entomology, University of Queensland on the second Monday of March-June and August-December each year. Meetings are announced in the Society's News Bulletin which also contains reports of meetings, entomological notes, notices of other Society events and information on Members' activities.

Enquiries relating to the Society should be directed to the Honorary Secretary, Entomological Society of Queensland, C/- Department of Entomology, University of Queensland, Brisbane, Qld, 4072.

Sustaining Associates

Arrest-A-Pest Pty Ltd, Rhone-Poulenc Rural Australia Pty Ltd.

Cover: Strepsiptera are entomophagous parasitoids which exhibit extreme sexual dimorphism, the males being winged and free-living while the wingless females are permanently endoparasitic in the host. The specimen illustrated belongs to the family Stylopidae and are parasites of Vespidae, Sphecidae and Apoidea. Illustration by Yanni Martin.

Printed by Hans Quality Print, 20 Lyons Terrace, Windsor, Qld, 4030

THE LIFE HISTORY OF *TRAPEZITES WATERHOUSEI* MAYO & ATKINS (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE)

Matthew R. Williams[1] and Andrew F. Atkins[2]

[1] *Department of Conservation and Land Management, 50 Hayman Road, Como, WA 6152*

[2] *Design Department, University of Newcastle, Newcastle, NSW 2308*

Abstract

The life history of *Trapezites waterhousei* Mayo & Atkins is described and illustrated. *Xerolirion divaricata* A.S. George (Dasypogonaceae) is the foodplant.

Introduction

Trapezites waterhousei Mayo & Atkins is distributed in south-western Western Australia from Payne's Find to Southern Cross and Koolyanobbing. The species has a highly disjunct distribution, being restricted to rocky outcrops where the foodplant occurs (Williams *et al.* 1996). There is a single annual generation and adults have been taken in September and October (Mayo and Atkins 1992, Williams *et al.* 1996). The foodplant was recorded by Williams *et al.* (1996), but the early stages have not previously been recorded.

Life History

Foodplant. Xerolirion divaricata A.S. George, family Dasypogonaceae (George 1986).

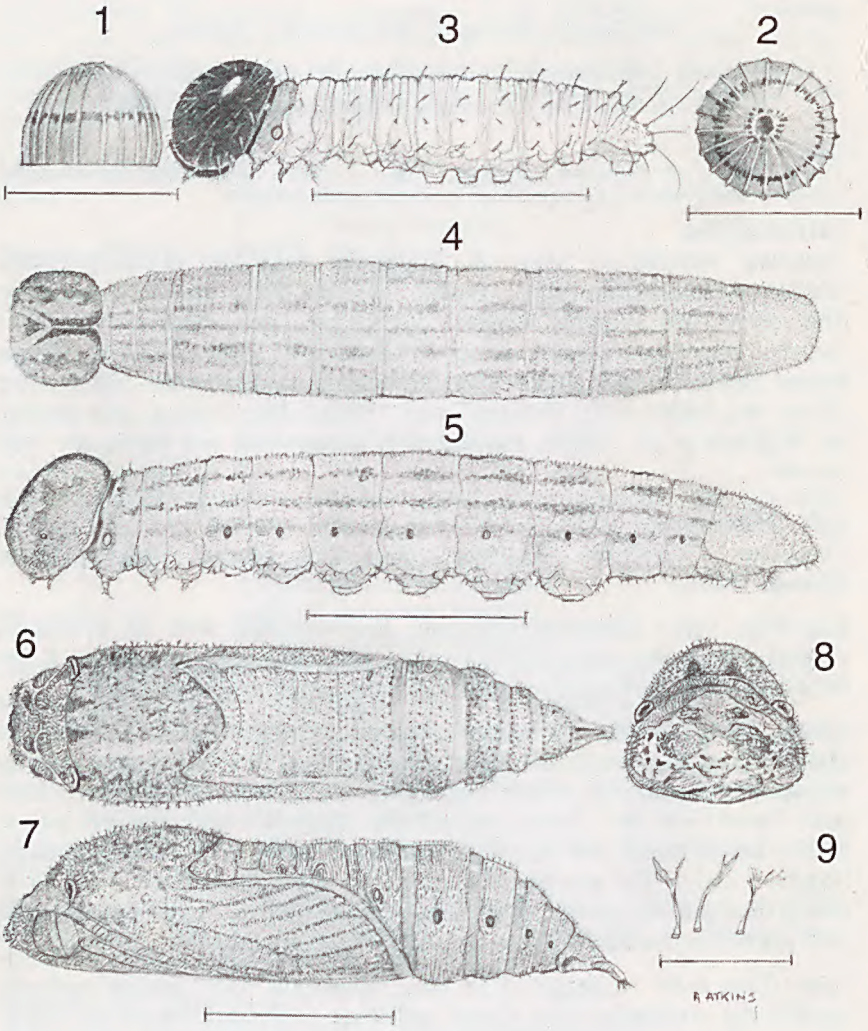
Egg (Figs 1-2). Diameter 0.70 mm, hemispherical, with 21 prominent vertical ribs; cream colored and unmarked when first laid, but within a few days developing a series of red markings laterally and on the micropyle.

Larva. 1st instar (Fig. 3) length 1.75 mm, head shiny black, prothoracic plate black. Body translucent, light brown, with a few long posterior setae, no prominent markings. Final instar (Figs 4-5) length 18-22 mm. Head light brown, with dark brown central line. Body pale light greyish brown, with a darker dorsal line and a pair of dorso-lateral lines extending along length of body. The area between the paired dorso-lateral lines is lighter in colour than the rest of the body. Head capsule rugose, light brown, frons with paired longitudinal dark brown bands diverging ventrally.

Pupa (Figs 6-9). Length 15-18 mm, cylindrical and tapering markedly towards the cremaster; head, thorax and wing cases dark brown to black, abdomen dark brown, banded with light brown; dorsal and lateral surfaces bearing numerous white setae.

Observations and Discussion

The early stages of *T. waterhousei* were located at a number of sites around Southern Cross in October 1993 and October 1994. Eggs were obtained from captive females using the technique described by Houston (1994).



Figs 1-9. Life history of *Trapezites waterhousei* Mayo & Atkins. (1-2) egg, lateral and dorsal views (scale line = 1.0 mm); (3) 1st instar larva, lateral view (scale line = 1.0 mm); (4-5) mature larva, dorsal and lateral views (scale line = 5.0 mm); (6-8) pupa, dorsal, lateral and frontal views (scale line = 5.0 mm); (9) pupal setae (scale line = 0.5 mm).

Larval shelters were located amongst the foliage of the foodplant, usually in a rolled dead leaf or piece of bark suspended in the foodplant. Other shelters were found that were constructed from leaves and stems of the foodplant. These types of shelters are typical of all Western Australian species of *Trapezites* Hübner. Whether these shelters may be constructed at a site distant from the foodplant, as was recorded by Williams *et al.* (1992) for *T. sciron* Waterhouse & Lyell, has not been determined. Pupation occurs within the shelters and most likely occurs in August and September. We have located mature larvae in October but these were not reared to adults and may have been parasitized.

In other Western Australian species of *Trapezites*, young, vigourously growing foodplants are apparently preferred for oviposition (Williams *et al.* 1992). We were unable to determine if such a preference exists in *T. waterhousei*, as at all of the sites where we observed this species the foodplants were undisturbed.

The early stages of *T. waterhousei* are typical for this genus and similar to those of *T. s. sciron* (Williams *et al.* 1992) and to Fisher's (1984) description of *T. s. eremicola* Burns. Together with the records of *T. s. sciron* feeding on *Acanthocarpus canaliculatus* and of *T. argenteoornatus* (Hewitson) feeding on *A. preissii* (Common and Waterhouse 1981) and other species of *Acanthocarpus* (pers. obs.), the Western Australian representatives of *Trapezites* represent the only members of the genus known to feed on any genus of plants other than *Lomandra*.

Xerolirion divaricata is an almost leafless small shrub restricted to laterite breakaways and rocky outcrops in the semi-arid zone of south-western Western Australia. It is closely allied to both *Lomandra* and *Acanthocarpus* (George 1986).

A further Western Australian species of *Trapezites* from Windy Harbour, south of Pemberton, again not feeding on *Lomandra*, is yet to be described (see Mayo and Atkins 1992). The phylogeny of this and other Western Australian species of *Trapezites*, particularly in relation to the biogeography of their associated foodplants, would no doubt reward further study. In particular, it would be of interest to determine if all of the Western Australian species are parapatric.

Voucher specimens relevant to this study are lodged in the insect collection, Department of Conservation and Land Management, Western Australia.

Acknowledgments
We thank Bob Hay, Trevor Lundstrom and Andrew Williams for assistance in locating the early stages of *T. waterhousei*. Andrew Williams, Judy Wheeler and an anonymous referee kindly reviewed an earlier draft of the manuscript.

References

COMMON, I.F.B. and WATERHOUSE, D.F. 1981. *Butterflies of Australia.* Angus and Robertson, Sydney.

FISHER, R.H. 1984. Life history of the sciron skipper *Trapezites sciron eremicola* Burns (Lepidoptera: Hesperiidae). *Transactions of the Royal Society of South Australia* **108**: 131-132.

GEORGE, A.S. 1986. *Xerolirion. Flora of Australia.* Vol. 46, pp. 98-100. Australian Government Printing Service, Canberra.

HOUSTON, T.F. (ed.) 1994. *Bring Back the Butterflies: Butterfly Gardening for Western Australians.* WA Museum, Perth.

MAYO, R.P. and ATKINS, A.F. 1992. *Anisyntoides* Waterhouse (Lepidoptera: Hesperiidae): a synonym of *Trapezites* Hübner, with description of a new species from Western Australia. *Australian Entomological Magazine* **19**: 81-88.

WILLIAMS, M.R., WILLIAMS, A.A.E. and ATKINS, A.F. 1992. The life history of the Sciron Skipper *Trapezites sciron sciron* Waterhouse and Lyell (Lepidoptera: Hesperiidae). *Australian Entomological Magazine* **19**: 29-32.

WILLIAMS, M.R., WILLIAMS, A.A.E., LUNDSTROM, T.E. and HAY, R.W. 1996. The distribution of Waterhouse's skipper *Trapezites waterhousei* Mayo & Atkins (Lepidoptera: Hesperiidae) in Western Australia. *Australian Entomologist* **23**: 83-85.

BOOK REVIEW

Riceland Spiders of South and Southeastern Asia, by A.T. Barrion and J.A. Litsinger, CAB International (in association with International Rice Research Institute), Wallingford, UK; 716 pp, 1995. US$ 225.

The scope of this work is prodigious and I know of no arachnologists who would have embarked on such a programme, which presumably had a time limit. So congratulations to A.T. Barrion and J.A. Litsinger for attempting this task. It is a weighty volume of 716 pp (including colour plates) in which 342 species are recognised in 131 genera from 26 families. Eight genera and 258 species are described as new.

The main aim of the publication was "to provide an illustrated guide that can be used by both specialists and novices to identify Philippine spiders". So, have they achieved this aim? Are their descriptions adequate, do the Keys work and can they be used by novices?

The most used characters in distinguishing species are the genital organs. Thus these require clearly labelled drawings. Fig 4a-i (p. 7) is the only figure which has labels on the genitalia. Unfortunately the drawings are poor. In the text (p. 5) the male palp is described thus - `the tarsal segment is enlarged, complicated and modified to form an intromittent organ for transmission of sperm to the reproductive system of the female during mating'. Figs 4a-f have a mish-mash of terms to completely confuse the novice. The embolus, the only sclerite which is easy to trace because the sperm duct enters it is never clear in any of the four illustrations in which it is labelled. On p. 8 we find the "epigynum is a highly complex structure and is of extreme taxonomic value, like the male's palpal tarsus (palpal bulb)". The introductory drawings of epigyna (Fig 4g-i) do not show any connection between the copulatory tube (insemination duct) and the spermatheca let along a fertilisation duct. Fig 4i which has a median septum labelled a `scape' seems to be *Argiope* sp, an araneid that does not have a scape. Figs 5-412 have no genitalic structure labelled. I consider this a great failing in a taxonomic work. To add further confusion the ventral (external) view of the epigynum is usually stated (in the legend) to be `dorsal' and vice versa (eg. Fig 42). The illustrations of body structure, excluding genitalia are good.

The classification is a strange amalgam of Simon (1892), Petrunkevitch (1933), Shear (note spelling) (1986) and others. In the Key to Families the Zodariidae are said to have `no cheliceral boss' which is incorrect; perhaps `no serrula' was intended.

I have little doubt that the new taxa are valid but regret more time for consultation with experts was not given in describing this collection. Seven of the 8 new genera are monotypic, i.e. have one species only and only one of these has both sexes represented. It is almost unbelievable in a collection of over 15,000 specimens that the `Material examined' comprises only a holotype and seldom more than one paratype; often there is no paratype. One of the aims (p. 1) of the authors was to establish sound reference collections - where can they be found and where have the type specimens been deposited?

Generic reference lists are sometimes incomplete leading to erroneous combinations eg. p. 612, *Larinia* - Levy (1986) recognised *Lipocrea* Thorell 1878 and its type species by designation, *L. fusiformis*.

Female *Achaearanea brookesiana* sp. nov. (Fig 261) looks very like cosmopolitan *A. tepidariorum*. The holotype is stated to be a male (not figured).

It is disappointing that there are few references later than 1989. Platnick's Catalogue 1988-1991 (1993) was obviously not available for checking the placement of genera in families and validity of species. There is a reference to Platnick *et al.* (1991) on p. 15 but it is not listed. Among earlier papers the omission of those of Chrysanthus (1958-1971) on New Guinea spiders is regretted. None of Levi's revisions of Araneidae are listed. There are omissions of acknowledgment to others. Davies (1986) key to families (in Australian Spiders .... Queensland Museum Booklet 14) appears to have been used in an abbreviated form for the key on p. 17; a few drawings from other publications have been used without acknowledgment.

A large map of the areas sampled would be more useful than a list of localities (p. 12). There are 336 very small (40 x 55 mm) maps. The numbers could be cut considerably by putting 3-4 species on the same map. As most sampling was done in Luzon province it scores more species than other places so in fact the distribution may be more about numbers of collections than distribution of species!

In answer to the question of whether the book meets its main aim as an illustrated guide to Philippine spiders, I would have to say that I doubt if specialists, let along novices, will find it easy to identify spiders beyond the genus level. However the book adds much to our knowledge of the spiders of Asia and for this we thank the authors.

V. Davies

Queensland Museum,
Brisbane.

TWO NEW SPECIES OF *TRAPEZITES* HÜBNER (LEPIDOPTERA: HESPERIIDAE: TRAPEZITINAE) FROM EASTERN AUSTRALIA

Andrew Atkins

The University of Newcastle, Newcastle, NSW 2308

Abstract

Trapezites genevieveae sp. nov. and *Trapezites taori* sp. nov. are described from the Great Dividing Range of eastern Australia. They inhabit particular biomes adjacent to those of closely related species, particularly *T. praxedes* (Plötz) and *T. symmomus* Hübner which have more extensive distributions along the coast and hinterlands. The adults and juveniles of both new species are illustrated and compared with their nearest allies.

Introduction

Several closely related species-groups of the endemic genus *Trapezites* Hübner occur along the coastal and sub-coastal regions of eastern Australia. They inhabit a wide variety of woodlands and heaths from sea-level to 1600 m (Common and Waterhouse 1981). Most species are widely distributed but local to certain biomes within their range. In the southern areas of Victoria and montane areas of New South Wales to northern Queensland they are univoltine; at lower altitudes from coastal New South Wales to northern Queensland they are generally bivoltine or multivoltine, some species flying throughout the year (Dunn and Dunn 1991).

With the exception of a few Western Australian species (Williams *et al.* 1992, Mayo and Atkins 1992, Williams and Atkins 1997), the larval foodplants of *Trapezites* are species of Matrush (*Lomandra*: Xanthorrhoeaceae), the larvae generally feeding at night and pupating within leaf litter near the base of the foodplant (Atkins 1987).

Trapezites have very similar dark brown and orange or yellowish maculation on the upperside of the wings but the species can be distinguished by a subtle variation of patterns and ground colour on the underside of the hindwing. Juveniles are distinguished by morphology and by colour patterns of the larval head and pupal cap (operculum). Adult taxonomic characters of the antennal club, wing venation and genitalia further separate the species and species-groups.

Four closely related taxa, *T. phigalioides* Waterhouse, *T. iacchoides* Waterhouse, *T. maheta* (Hewitson) and *T. praxedes* (Plötz), plus a fifth more distantly related species *T. symmomus* Hübner, are found along the moist coastal or montane heaths and woodlands along the Great Dividing Range. The latter three taxa are widely distributed throughout temperate and/or subtropical biomes in eastern Australia.

From 1989-1996 a series of pale trapezitine larvae was collected from a species of *Lomandra* growing at altitudes between 200-800 m in the dense subtropical and temperate rainforests of central montane New South Wales

and southern Queensland. The larvae, pupae and the subsequently reared adults were compared with those of a series of *T. praxedes* from central coastal New South Wales and southern Queensland. The rainforest specimens differ both in structure and biology from *T. praxedes* but the adults resemble specimens collected earlier (1911, 1967-68) at two localities adjacent to rainforest in New South Wales. Consistent characters of behaviour and structure distinguish the rainforest populations from *T. praxedes* and *T maheta*. Biological and distributional observations have added to the evidence that they represent a distinct species.

In 1972-73 and 1995-96 several specimens of an unusual *Trapezites* were collected at an elevation of 900 m on the Blackdown Tableland, Expedition Range, central Queensland (see Atkins 1974). Both sexes show a close affinity with *T. symmomus* but are somewhat smaller and duller. The habitat at this location is mixed heath and woodland. Other central Queensland records include a specimen observed at Springsure by the late J.C. Le Souëf (1975) and another collected at Isla Gorge in 1991 by R. Eastwood (pers. comm.). These areas are west of the nearest recorded locality for *T. symmomus* at Kroombit Tops, near Gladstone. *T. symmomus* is known also from the Eungella Range west of Mackay (Valentine 1988, Braby 1994), with reared specimens collected from *Lomandra longifolia* (pers. obs.).

The described subspecies of *T. symmomus*, *T. s. soma* Waterhouse from Victoria and *T. s. sombra* Waterhouse from north Queensland, differ to only a limited degree from the typical subspecies from central coastal Queensland (including Kroombit Tops) and probably represent a cline. The species occurs in a variety of habitats from coastal heaths to montane woodlands where mostly it is univoltine. The larvae feed on several species of *Lomandra*, particularly *L. longifolia*. Morphological, biological and distributional comparisons of these phenotypes indicate that the inland central Queensland populations are specifically distinct.

Methods

Most *Trapezites* can be reared on a range of species of *Lomandra* under laboratory conditions although sometimes the adults are smaller (pers. obs., n=15 spp., 300-350 specimens). Adult female *Trapezites* were collected in the field and placed in net-covered pots containing various species of *Lomandra* and fed for 3-5 days with water and honey mixture. Eggs were collected from the leaves of the foodplant, leaf litter placed around the pots and from the netting.

Abbreviations

Abbreviations of collections where specimens are housed, are as follows: ANIC, Australian National Insect Collection Canberra; BMNH, The Natural History Museum, London; NMVM, National Museum of Victoria, Melbourne; AA, Andrew Atkins collection; RE, Rod Eastwood collection; RM, Russell Mayo collection. Rearing details are given as follows: RXE = reared from egg; RXL= reared from larvae.

Key to males of the *maheta* and *symmomus* species groups

1 Adults medium to large (forewing length 17-20 mm), hindwing underside yellowish-brown, reddish-brown or pale greyish-brown with silver or whitish spots 5
Adults medium to small (forewing length 12-16 mm), hindwing underside dark grey and greyish-brown to purple-brown, silver spots absent or present 2

2 Hindwing underside with dark spots, prominently centred with silver scales 3
Hindwing underside with broadly ringed dark spots centred with grey scales ..... *phigalioides*

3 Hindwing underside with the two central (median) silver spots moderate and distally placed, with pointed forewing and termen comparatively straight 4
Hindwing underside with the two central (median) silver spots large and basally located, with forewing short and termen usually comparatively rounded ..... *maheta*

4 Hindwing underside grey to greyish-brown, 2 median and 2 or 3 subtornal silver spots; forewing underside with grey inner margin ..... *praxedes*
Hindwing underside brown to purplish-brown, 2 median and 5 or 6 subtornal to apical silver spots; forewing underside with yellow inner marginal smudge ..... *genevieveae* sp. nov.

5 Hindwing underside dark brown or yellow-brown, the central (median) silver spot large 6
Hindwing underside pale grey-brown, with 2 median and 7 or 8 subtornal to apical medium to small brown-ringed silver spots ..... *iacchoides*

6 Hindwing underside dark reddish-brown, subtornal to apical spots prominent ..... *symmomus*
Hindwing underside dull yellowish-brown, subtornal to apical spots obscured ..... *taori* sp. nov.

Key to females of the *maheta* and *symmomus* species groups

1 Adults medium to large (forewing length 20-25 mm), hindwing underside yellowish-brown, reddish-brown or pale greyish-brown, with silver or whitish spots 5
Adults medium to small (forewing length 15-19 mm), hindwing underside dark grey and greyish-brown to purple brown, with or without whitish spots 2

2 Hindwing underside with smallish dark spots centred with grey scales 3
Hindwing underside with broadly ringed dark spots centred with grey scales ..... *phigalioides*

3 Forewing pointed and termen comparatively straight 4
Forewing short and termen comparatively rounded .....*maheta*

4 Hindwing underside grey to greyish-brown with small dark spots; forewing underside with pale grey inner margin .....*praxedes*
Hindwing underside rich greyish-brown with prominent dark spots, often centred with whitish scales; forewing underside with pale yellow inner margin .....*genevieveae* sp. nov.

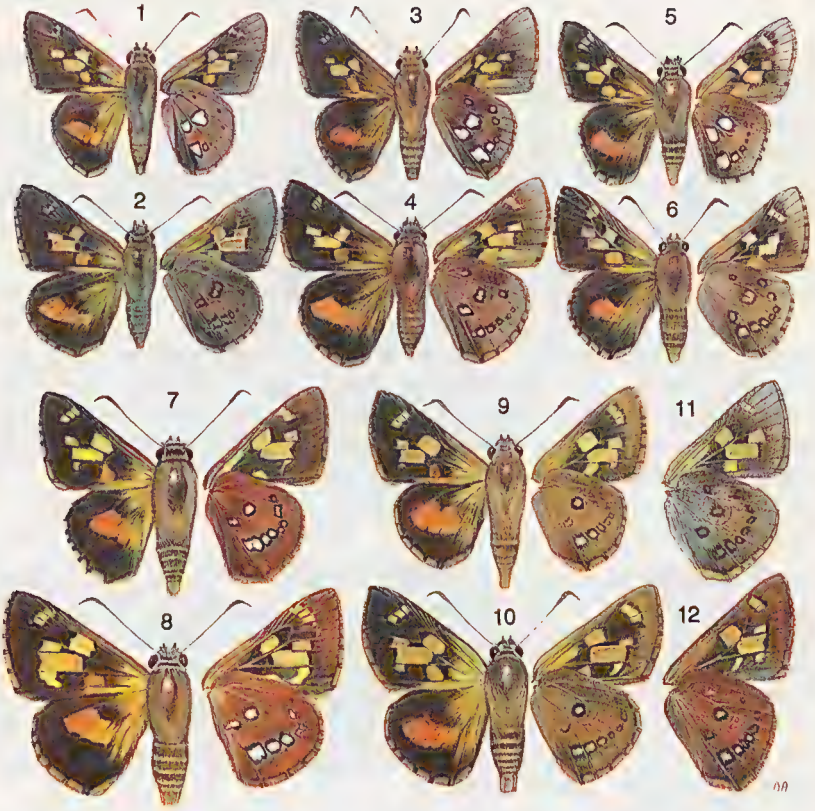
5 Hindwing underside dark brown or yellow-brown, the central (median) spot large 6
Hindwing underside pale grey-brown, with 2 median and 7 or 8 subtornal to apical medium to small brown-ringed silver spots ..... *iacchoides*

6 Hindwing underside dark reddish-brown, subtornal to apical spots prominent .....*symmomus*
Hindwing underside dull yellowish-brown, subtornal to apical spots obscured ..... *taori* sp nov.

Females of *T. phigalioides, T. maheta, T. praxedes* and *T. genevieveae* are difficult to distinguish and somewhat variable. Some characters overlap, but those presented above are consistent in fresh (or reared) specimens.

Trapezites genevieveae sp. nov.
(Figs 3-4, 13-14, 25-27, 31-32, 34-41)

Types. NEW SOUTH WALES: *Holotype* ♂, Barrington Lodge, RXL, 1.xi.1989, A.F. Atkins (ANIC, genitalia dissected). *Paratypes*: 1 ♀, Mt Allyn (River), RXL, 26.xi.1992, A.F. Atkins (ANIC); 1 ♀, Bruxner Park, Coffs Harbour, 28.x.1993, A.F. Atkins (ANIC); 1 ♀, Bruxner Park, Coffs Harbour, RXL, 2.xi.1993, A.F. Atkins (BMNH); 1 ♀, Bruxner Park, Coffs Harbour, RXE, 28.xi.2995, A.F. Atkins (RM); 2 ♀, Middle Brother, 29.xii.1994; 1 ♂, Barrington Lodge (Salisbury), RXL, 12.xi.1992; 1 ♀, Barrington Lodge, Williams River, RXL, 16.xi.1990; 1 ♂, 3 ♀, Barrington Lodge, RXL, 26.x.1990, 21.xi.1992, 1.xii.1992 & 27.xii.1992; 1 ♂, 2 ♀, Wilson River, RXL, 29.xi.1992 & 18.xii.1992; 1 ♂, 1 ♀, 'Grandis', 20km NE of Bulahdelah, RXL, 4.i.1995 & 2.xii.1995; 1 ♂, 1 ♀, Copeland, RXL, 17.x.1994 & 5.xi.1994; 1 ♂, Mt Allyn, RXL, 15.xi.1992; 1 ♂, 2 ♀, Allyn River, RXL, 1.xii.1992, 2.xii.1992 & 7.xii.1992; 1 ♂, Allyn River, Barrington area, RXL, 21.xi.1992; 1 ♀, Upper Allyn, Barrington Range, RXL, 5.xii.1990; 1 ♀, Gloucester River, RXL, 22.xi.1992; 2 ♂, O'Sullivan's Gap, Bulahdelah,, 12.xii.1994; 1 ♀, O'Sullivan's Gap, RXL, 2.xii.1995; 1 ♂, 3 ♀, Bruxner Park, Coffs Harbour, RXL, 25.x.1993, 4.xi.1993, 17.xi.1993 & 16.xi.1994; 3 ♂, 1 ♀, Bruxner Park, Coffs Harbour, RXE, 1.xi.1995 & 28.xi.1995; 1 ♂, 2 ♀, Bruxner Park, Coffs Harbour, 7.i.1993 & 29.xii.1994; 5 ♂, 5 ♀, Dorrigo, RXL, 2.x.1993, 8.x.1993, 12.x.1993, 19.x.1993, 21.x.1993, 29.x.1993, 4.xi.1993, 16.xi.1993 & 29.ix.1993; 1 ♂, 1 ♀, Boorganna Reserve, Comboyne, RXL, 26.x.1995 & 28.xi.1995; all reared or collected by A.F. Atkins (all AA). QUEENSLAND: 1 ♀, Mt Glorious, RXL, 25.xii.1994, A.F. Atkins (AA).



Figs 1-12. Adult *Trapezites* spp. (1-10, upperside left, underside right; 11-12, underside): (1) *T. praxedes* male, Catherine Hill Bay, NSW; (2) *T. praxedes* female, Port Stephens, NSW; (3) *T. genevieveae* male, Barrington Lodge, NSW; (4) *T. genevieveae* female, Mt Allyn, NSW; (5) *T. maheta* male, Busby Flat, NSW; (6) *T. maheta* female, Byfield, Qld; (7) *T. s. symmomus* male, Narrara, NSW; (8) *T. s. symmomus* female, Dudley, NSW; (9) *T. taori* male, Blackdown Tableland, Qld; (10) *T. taori* female, Blackdown Tableland, Qld; (11) *T. praxedes* female, Mt Glorious, Qld; (12) *T. symmomus sombra* male, Herberton, Qld. Scale bar = 10 mm.

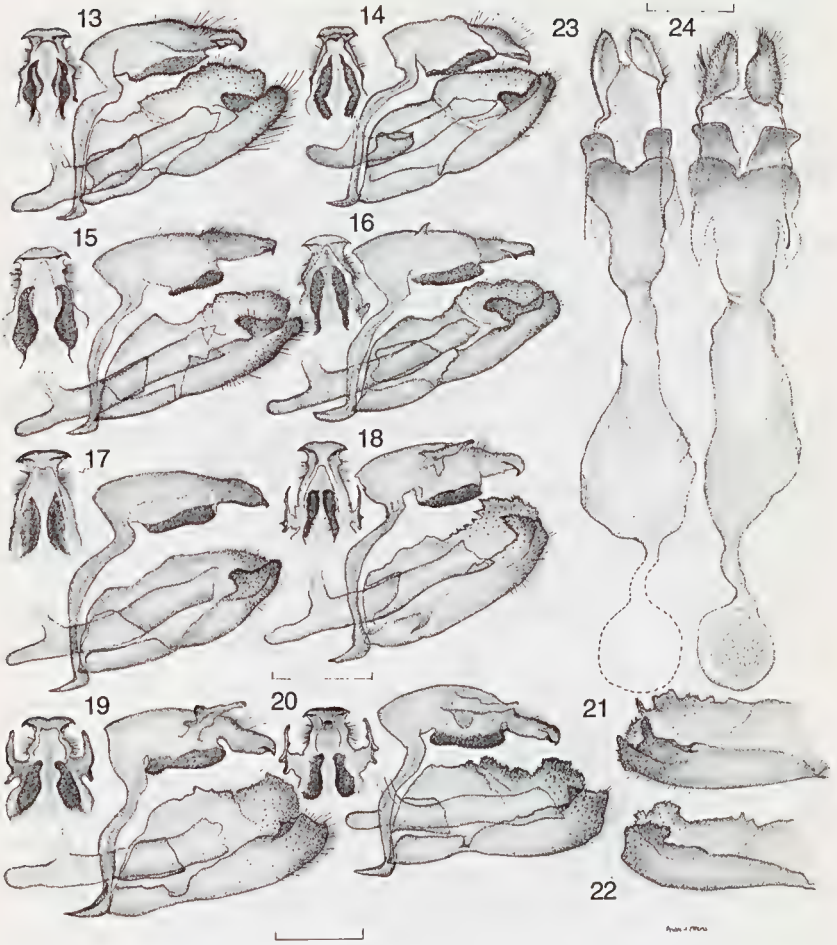
Description. Male (Fig. 3). Head, labial palpi and anterior of thorax above covered with brown hairs, below covered with pale cream hairs, posterior of thorax and abdomen covered with yellow, brown and pale brown hairs, below covered with light fawn hairs; eyes dark brown; antennae with shaft and base of club black, segmented with pale yellow scales; below club pale yellow; nudum (24 segments) rust coloured. Forewing above: length 17-18 mm; ground colour dark reddish-brown to black, costa and base of discal cell covered with reddish brown scales, base of wing and inner margin with patch of yellow-orange hairs; sub-elliptical patch of yellow scales in submedian area between 1A+2A and CuA_2; a hyaline yellowish wedge-shaped subcostal spot in cell; a small hyaline quadrate spot in postmedian area between CuA_1

and M_3, a larger wedge-shaped hyaline spot between CuA_1 and CuA_2, three small subapical hyaline spots; cilia pale brown. Hindwing above: ground colour dark reddish-brown to black, base and anal vein area with long yellow-orange hairs, central median-postmedian area with irregular patch of bright yellow-orange scales and hairs; cilia pale yellowish-brown from apex to pale orange at tornus. Forewing below: ground colour pale reddish-brown, base and central area black; inner margin area greyish-brown and adjacent area above 1A+2A (variable from tornal area to submedian area) covered with pale yellow scales. Hindwing below: ground colour greyish-brown to black at tornus, central area pale reddish-brown; two large sub-crescent median silver spots in cell and between 1A+2A and CuA_2; one large subtornal quadrate silver spot between 1A+2A and CuA_2 and two smaller subterminal silver spots between CuA_2 and CuA_1 and CuA_1 and M_3; two small obscure dark brown subterminal spots between M_3, M_2 and M_1; two postmedian silver spots between M_1, Rs and $Sc+R_1$.

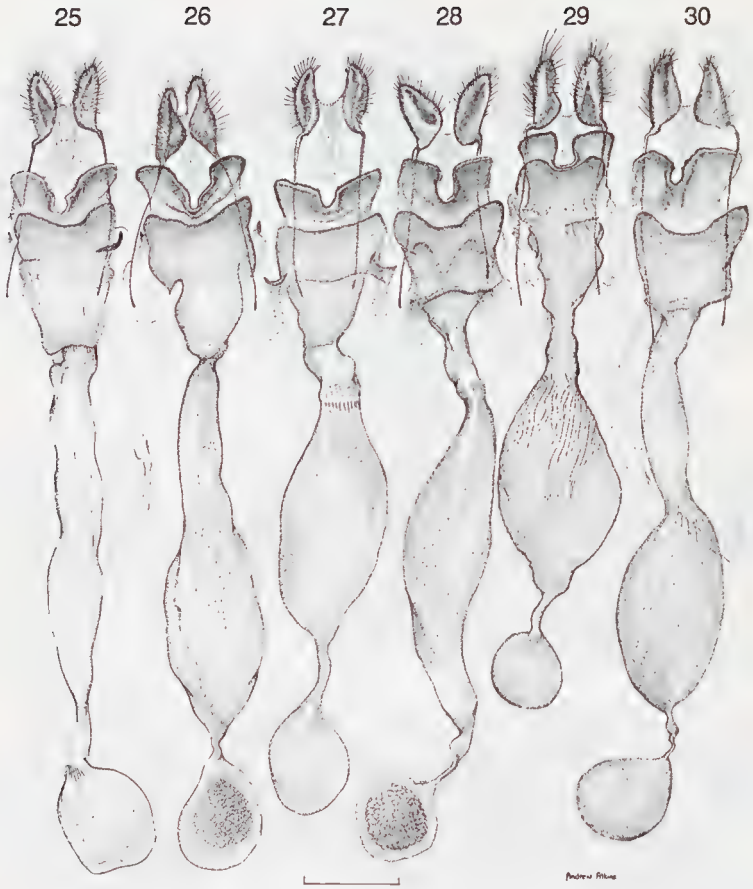
Male genitalia (Figs 13-14). Combined tegumen and uncus long, distally crinose, projecting to simple toothed uncus tip (see inset, Figs 13-14); lateral flanges absent; gnathos sclerotized and slightly projecting; saccus short and curved. Valvae long, quadriform to oval, distally pointed, sclerotized and crinose; ampulla rounded (in left valva, slightly decurved and broadly blunt); sacculus curved and sclerotized to upcurved harpe (blunt in left valva); long, bent, proximally placed dorsal process; aedeagus long, broad and simple with wide postzone; juxta saddle-shaped.

Female (Fig. 4). As in male but forewing more convex, length 17-20 mm, hyaline spots generally larger. Hindwing more convex, upperside central bright yellow-orange patch broad across wing. Forewing below with grey terminal and subterminal area between M_1 and CuA_1; pale yellow scales above 1A+2A prominent and extending generally across wing. Hindwing below pale greyish-brown with central area and tornal area orange-brown; a band of eight dark brown postmedian-subterminal spots variably centred with white scales between 1A+2A and $Sc+R_1$; a dark brown spot centred white near base of $Sc+R_1$ and Rs; a double white-centred spot near proximal end of cell; two white-centred dark brown submedian spots between 3A, 1A+2A and CuA_2.

Female genitalia (Figs 25-27). Papilla analis long, craticular and crinose with long straight apophysis; lamella post-vaginalis broadly spaced and V-shaped covered with minute setae; lamella ante-vaginalis broad, quadriform, slightly depressed at centre; ductus bursae and caudal chamber narrow; corpus bursae



Figs 13-24. Male and female genitalia of *Trapezites* spp. (inset = slightly enlarged dorsal view of uncus): (13) *T. genevieveae* HT, Barrington Lodge, NSW; (14) *T. genevieveae*, Bruxner Park, NSW; (15) *T. praxedes*, Whitebridge, NSW; (16) *T. praxedes*, Mt Binga, Qld; (17) *T. maheta*, Gympie, Qld; (18) *T. taori*, Blackdown Tableland, Qld; (19) *T. symmomus*, Eungella, Qld; (20) *T. symmomus*, National Park (Sydney), NSW; (21) inside left valva *T. taori* HT, Blackdown Tableland, Qld; (22) inside left valva *T. symmomus*, National Park (Sydney), NSW; (23) female genitalia *T. taori*, Blackdown Tableland, Qld; (24) female genitalia *T. symmomus*, Mt Dromedary, NSW. Scale bars = 1 mm (inset of uncus slightly larger).



Figs 25-30. Female genitalia of *Trapezites* spp: (25) *T. genevieveae*, Mt Allyn, NSW; (26) *T. genevieveae*, Middle Brother, NSW; (27) *T. genevieveae*, Mt Glorious, Qld; (28) *T. praxedes*, Mt Glorious, Qld; (29) *T. praxedes*, Caves Beach, NSW; (30) *T. maheta*, Byfield, Qld. Scale bar = 1 mm.

long, broadly ovoid and slightly sclerotized; accessory pouch large and ovoid.

Variation. Populations vary slightly in adult size and in the number and size of the underside hindwing spots of the male. These spots tend to be larger and prominent in southern populations, whereas in the north the spots between Sc+R_1 and Rs are occasionally absent. The yellowish smudge along

1A+2A is always present on the underside of the forewing in both sexes but it is variable in size in the male. The white-centred spots on the underside of the hindwing of the female are variable in size and sometimes absent. Larvae and pupae vary little in colour although northern specimens tend to be slightly darker.

Etymology. The species is named for the artist and field/photographic assistant Genevieve Wallace, whose help, advice and research with this skipper and many other Hesperiidae in London, Germany, Kenya, Hong Kong and Costa Rica have been greatly appreciated and invaluable.

Distribution. Confined to the eastern slopes of the Great Dividing Range east of a line from Scone, New South Wales to Cunningham's Gap and Montville, Queensland. In the south it is found from widely scattered montane areas of temperate and subtropical old-growth rainforest of the Barrington Ranges to the near-coastal forests surrounding Bulahdelah, north through the hinterlands of montane New South Wales to the Border Ranges and in elevated rainforests near Brisbane north to the Nambour district of southern Queensland. Additional localities (larval records) have been found throughout the range of this rare skipper; they include: Tallowwood Forest, Cabbage-tree Mountain (north-west of Bulahdelah), North Brother (near Laurieton), the hinterland of Wauchope and Kempsey, the Nightcap Range, Minyon Falls and Terania Creek (all north-west of Lismore), Lamington Plateau and Binna Burra areas in the Border Ranges, Cunningham's Gap and Kondilla National Park, Montville.

Trapezites taori sp.nov.
(Figs 9-10, 18, 21, 23, 42-43, 45-48)

Types. QUEENSLAND: *Holotype* ♂, Blackdown Tableland, Expedition Range, Central Queensland, 26.viii.1973, A.F. Atkins (ANIC). *Paratypes*: 2 ♂, same locality, 23.ix.1973 & 24.ix.1973, J.C. Le Souëf; 6 ♂, 7 ♀, same locality, 16.ix.1972, 23.ix.1972, 22.ix.1973, 22.ix.1973, 26.ix.1973, 27.ix.1973, 27.iv.1974, 27.iv.1974, 26.ix.1974, 27.ix.1974 & 27.x.1974, A.F. Atkins (all ANIC); 9 ♂, 2 ♀, same locality, 20.viii.1995, 21.viii.1995, 22.viii.1995 & 23.viii.1995, A.F. Atkins (all AA); 1 ♂, same locality, 23.viii.1995, A.F. Atkins (RM); 1 ♂, Isla Gorge South, Central Queensland, 31.iii.1990, R. Eastwood (RE).

Description. Male (Fig. 9). Head, labial palpi and anterior of thorax above covered with brown hairs edged paler brown, thorax and abdomen covered with greyish-yellow hairs, abdominal hair tuft tipped yellow; below labial palpi and anterior of thorax with pale cream hairs, remainder covered with cream and fawn hairs, reddish-orange at abdominal tip; eyes dark brown. Antennal shaft and club above black, nudum (29 segments) orange-brown; below club pale orange-brown. Forewing above: length 19-21 mm; ground colour dark brown, base of discal cell and costa covered with orange-brown scales; base of wing and inner margin with patch of yellow-orange hairs;

subelliptical patch of yellow scales in submedian area between 1A+2A and CuA_2; a hyaline yellowish wedge-shaped subcostal spot in cell; a small hyaline quadrate spot in postmedian area between CuA_1 and M_3; a large wedge-shaped hyaline spot between CuA_1 and CuA_2; a small, often obscured crescentic spot of orange scales in postmedian area immediately below CuA_2; three small subapical hyaline spots; cilia pale yellowish-brown. Hindwing above: ground colour dark brown, base and anal vein area with long yellow hairs, central median-postmedian area with an irregular patch of bright yellow scales and hairs; cilia yellow-orange, darker at tornus. Forewing below: ground colour yellowish-brown, base and central area dark brown; inner margin area greyish-brown; hyaline spots and yellowish spots as above but paler and slightly larger, smudged in spot between CuA_1 and CuA_2. Hindwing below: ground colour yellowish-brown, paler in central area, a curved row of 6 dark brown-black spots, centred bluish-grey, tapering down between 1A+2A and Rs; a large central black spot, centred with bluish-grey scales.

Male genitalia (Figs 18, 21). Combined tegumen and uncus long, extending to a simple, flared dentate tip (see inset, Fig. 18); lateral flanges well developed and protruding distally; gnathos with paired, sclerotized, subovoid processes proximally placed; saccus short and curved. Valvae long, distally crenulate and crinose, bent upward; left valva (Fig. 21) with ampulla variably dentate, saccus with harpe squared, deeply divided to a short crenulate process; right valva (Fig. 18) curved and evenly dentate; ampulla rounded ventrally and concave dorsally, deeply crenulate, saccus with harpe curved dorsally and pointed; aedeagus long, broad and curved; juxta saddle-shaped.

Female (Fig. 10). As in male but forewing slightly more convex, length 21-23 mm; hyaline spots and yellowish spots generally larger; hindwing more convex.

Female genitalia (Fig. 23). Papilla analis long, craticular and crinite with apophysis long and slightly curved; lamella post-vaginalis broadly divided and straight with rounded tips; lamella ante-vaginalis broad, irregularly depressed centrally; ductus bursae and caudal chamber narrow; corpus bursae long, ovoid with spherical accessory pouch.

Variation. Very little variation has been observed from the limited material available. Adults differ slightly in size and size of maculation.

Etymology. Taori is an aboriginal word for country, territory or hunting ground, especially for limited natural boundaries such as mountains, ridges and rivers.

Distribution. Recorded from Expedition Range and Isla Gorge, with one observation at Springsure in the Central Highlands, Central Queensland. Similar habitats occur widely throughout the sandstone rangelands from

Robinson Gorge National Park, Mount Moffatt, Carnarvon Ranges and possibly west to the Salvator Rosa National Park. It may occur also in northern Queensland.

Life histories and biology

Trapezites genevieveae

Larval foodplant. Lomandra spicata A. Lee, occasionally *Lomandra hystrix* (R.Br.) L. Fraser & Vick. and possibly *Lomandra longifolia* Labill. (Xanthorrhoeaceae).

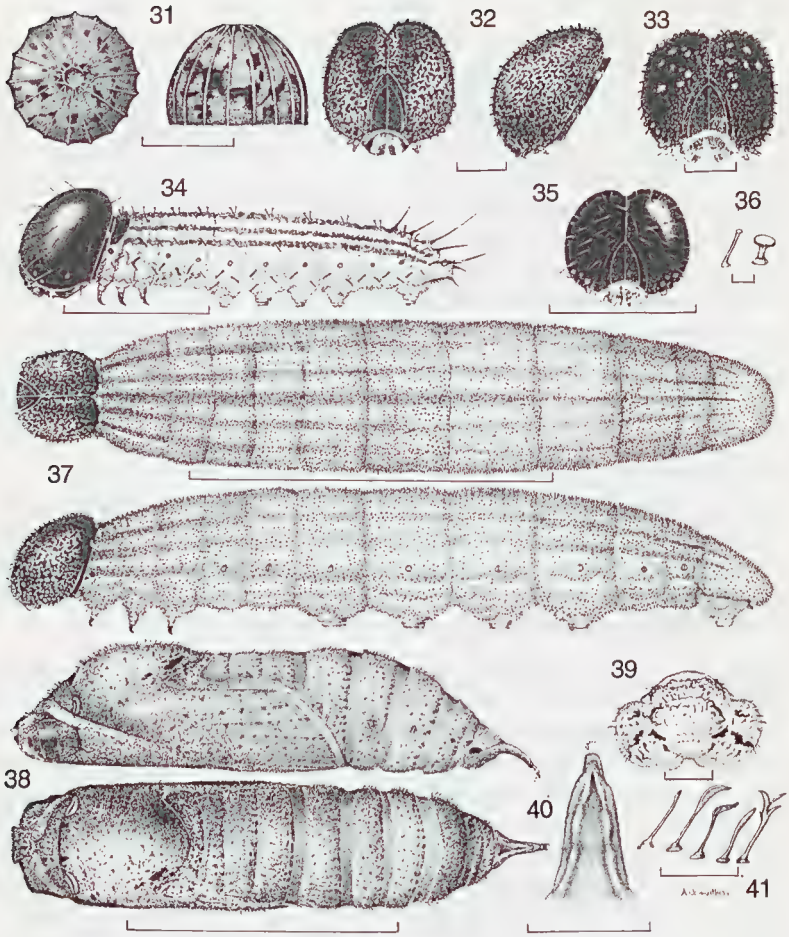
Egg (Fig. 31). Diameter 1.5 mm, hemispherical, with 17-20 prominent vertical ribs; off-white to pearl coloured and unmarked when first laid, creamish-white with pink micropyle and scattered pattern of lateral markings developing after 2-3 days.

Larva. 1st instar (Figs 34, 35). Length 3 mm, head shiny black and covered lightly with long setae, prothoracic plate brown; body straw-coloured, longitudinally striped with reddish dorsal, subdorsal and lateral bands and covered with short, slightly clubbed setae; longer plain setae on posterior segments.

2nd-5th instars (Figs 32, 37). Length 5-45 mm. Head pinkish-brown mottled with darker rugose markings on lateral and basal areas, dorsal area covered with short cup-shaped setae (Fig. 36); body greyish-fawn to pinkish-brown covered with dark brown speckled markings that form dorsal, subdorsal and lateral bands, darker on anterior and posterior segments.

Pupa (Fig. 38). Length 20-22 mm, cylindrical, tapering moderately to fairly long, decurved cremaster (Fig. 40) with rounded tip; frons pale brown, sclerotized with two central and two dorsal slightly raised areas; body pale pinkish-brown mottled with darker small brown markings, larger on dorso-posterior of thorax and two prominent brown dorso-anterior markings on thorax; covered with short, slightly branched, flattened or simple setae (Fig. 41); anterior covered with whitish waxy powder.

Biology. The egg is laid at the base of the foodplant or on surrounding leaf litter and hatches after 10-15 days. The young larva develops slowly in autumn and winter, eating at first from the edges of new foliage. Later instars cut distinctive oblique slices across the leaf-blade. The final instar larva constructs a lightly woven shelter amongst ground debris of damp, rotted and mouldy leaves and twigs. A diapause of the final instar larva occurs late September/October to November (lasting 6-9 weeks) when feeding is discontinued until pupation. Larvae and pupae are a distinctive pale pink to light brown colour. The pupation site is usually in the final larval shelter, which may be a metre or more from the foodplant. Adults emerge in 12-20 days.



Figs 31-41. Life history of *T. genevieveae* from Barrington Ranges, NSW (and comparative larval head of *T. maheta* from Byfield, Qld): (31) dorsal and lateral view of egg; (32) frons and lateral view of final instar larval head; (33) frons of larval head of *T. maheta*; (34) 1st instar larva; (35) frons of 1st instar; (36) mature larval setae; (37) dorsal and lateral view of final instar; (38) lateral and dorsal view of pupa; (39) operculum of pupa; (40) cremaster of pupa; (41) pupal setae. Scale bars (36, 41) = 0.5 mm; (31-35, 39-40) = 1 mm; (37-38) = 10 mm.

T. genevieveae is confined to dense 'old-growth' primary subtropical and temperate rainforest, particularly in montane biomes at altitudes between 200-800 m. Typical habitats include dense canopy forests in valleys, ravines, rocky riverine gorges and sheltered slopes dominated by 50-60 m tall hardwoods of *Eucalyptus grandis* (Flooded Gum), *Eucalyptus saligna* (Sydney Blue Gum), *Eucalyptus microcorys* (Tallowwood) and many other trees such as *Archontophoenix* (Bangalow Palm) and *Livistona* (Cabbage Palm). The skipper also extends into upland temperate rainforests. The ground cover in these habitats is often sparse with *Lomandra spicata* the principal herb, a medium-sized tussock that grows locally in dark, damp undergrowth areas and often on rocky slopes bordering streams.

Adults are rarely observed. They fly mostly around the sunny openings of the upper or mid-canopy, males choosing perching and patrolling sites during the day. In the early morning and late afternoon both sexes often settle low in sunlit glades or visit *Lantana* flowers. The species is univoltine, the adults fly only in the warmer, wetter months between November and March but appear to be most abundant in early December (pers. obs. in field and from reared specimens).

Colonies of juveniles can be detected by web trails and the distinctive fresh oblique cuts to the leaves of the foodplant but during the diapause (final instar) phase the larvae are difficult to detect, due to the absence of fresh feeding signs and the distance of the prepupal shelter site from the foodplant. At Mount Cordeaux (Cunningham's Gap, Qld), final instar larvae can be detected by fresh feeding signs in October at higher altitudes above 700 m. It is not clear if individuals at this altitude have a shorter diapause and/or a slower metabolism than specimens at lower altitudes. In some rainforest areas (e.g. Bruxner Park and Comboyne Plateau, NSW, Montville, Qld) the foodplants appear to include *Lomandra hystrix*, a riverine plant widely distributed in eastern Queensland and north-eastern New South Wales.

Lomandra spicata is easily recognised by the decorative bright orange seeds and soft, dark green foliage. It is not uncommon but local from sea-level to 900 m, restricted to colonies scattered through the dark floor of primary rainforest. It also reaches into subalpine Beech (*Nothofagus*) forests at the Barrington and Border Ranges and also in littoral rainforest and coastal vine-forest (eg. Booti Booti National Park, NSW) but *T. genevieveae* appears to be absent from these climatic extremes. *Lomandra spicata* is also recorded from the Atherton Tableland, north Qld and further south on the border at Mt Lindsey, Mistake Range and Whian Whian State Forest (Lee and Macfarlane 1986).

Trapezites taori

Larval foodplant. Not recorded but probably *Lomandra* sp. (Xanthorrhoeaceae). There are at least seven species in the area, including *L.*

longifolia and *L. multiflora*. Reared larvae fed on several species of *Lomandra*.

Egg (Fig. 42). Diameter 1.2 mm, pale green to yellowish; reddish-brown patches appearing on dorsal and lateral areas on third day.

Larva. 1st instar (Figs 45-46). 3 mm long; head shiny black with several pale setae on dorsal and lateral surfaces; body straw-coloured with one dorsal and 6 dorsolateral, longitudinal reddish stripes, covered with dark, medium clubbed setae; four pairs of long setae on posterior segments.

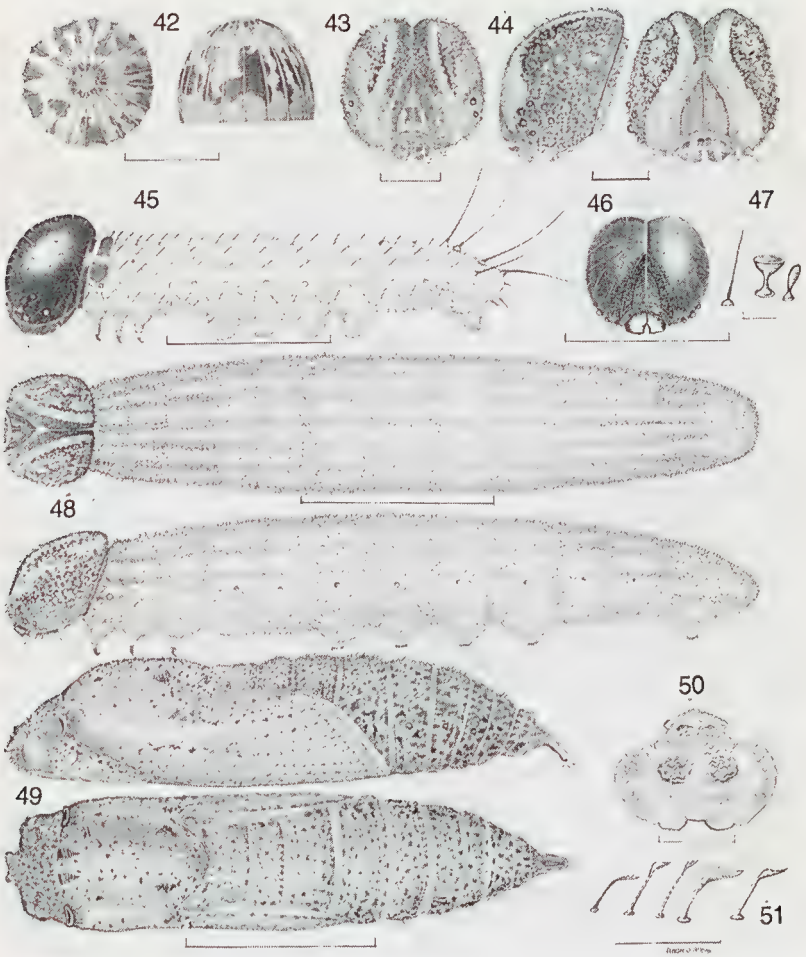
2nd-4th instar. 10-15 mm long; head sclerotized, brown to dark brown; paler markings (variable) on dorsal area forming an upturned Y-shaped marking centred by a dark area to frons, grooved dorsally; body translucent grey-green to purplish-pink at anterior and posterior segments; a series of 7 dark grey-green and 5 pale green dorsal and dorsolateral, longitudinal bands.

Final instar (Figs 43, 48). Length 39-41 mm; head moderately sclerotized, dark brown with lighter brown maculation on lateral surfaces and inverted V-shaped marking at frons; body translucent greyish-green covered with short pale spinules (Fig. 47), a dark dorsal line along length of body and two dark dorsolateral lines on anterior segments.

Pupa. Unknown, but probably similar to that of *T. symmomus* (Figs 49-51).

Biology. Oviposition by captured females was on both the foodplant and litter substrates. Juveniles and the larval foodplant of *T. taori* have not been discovered in the field, but caged larvae readily accepted *L. longifolia, L. hystrix* and *L. spicata*. Unlike *T. genevieveae* but like *T. symmomus*, the larva grows steadily without apparent diapause, eating at dusk and sometimes at dawn, the feeding sites being erratically chosen from the edges of several leaves each night. Maturity was reached by March and April from eggs laid in September. The larvae are similar to those of *T. symmomus* but the head is darker with a narrow pale band, the body more translucent and banded. As in other species, the larval shelters are silk-woven leaves of the foodplant (especially early instars) and leaf-litter near the base of the plant. It is expected that pupation takes place in the final instar shelter. Reared larvae (n=22) all eventually succumbed to a devastating virus brought in on a batch of *T. phigalioides* larvae from the Grampians, Victoria, although *T. symmomus* larvae from Eungella Range, Qld, remained unharmed. The pupa, operculum and pupal setae of *T. symmomus* are illustrated (Figs 49-51), which hopefully may assist in the discovery of the pupa of the closely allied *T. taori*.

Adults of *T. taori* fly powerfully and rapidly 2-3 m above the ground. In the early morning adults sun themselves on stones and low vegetation in open sandy patches of heathland. Later in the morning and in late afternoon both sexes are attracted to flowers, particularly *Xanthorrhoea johnsonii* A. Lee, *Leptospermum flavescens* Sm. in spring and *Banksia oblongifolia* Cav. in autumn. Males have been observed patrolling 'territories' in clearings of



Figs 42-51. Life history of *T. taori* from Blackdown Tableland, Qld (and comparative larval head and pupa of *T. symmomus* from Dudley, NSW): (42) dorsal and lateral view of egg; (43) frons of mature larval head; (44) lateral and frons view of mature larval head of *T. symmomus*; (45) 1st instar larva; (46) frons of 1st instar larval head; (47) mature larval setae; (48) dorsal and lateral view of mature larva; (49) lateral and dorsal view of pupa of *T. symmomus*; (50) operculum of *T. symmomus*; (51) pupal setae *of T. symmomus*. Scale bars (47, 51) = 0.5 mm; (42-46, 51) = 1 mm, (48-49) = 10 mm.

woodland near ridges, settling on low vegetation. *T. taori* flies with *T. phigalia* (Hewitson), *T. eliena* (Hewitson), *T. maheta* and *T. petalia* (Hewitson) but has a stronger, more elevated flight than these species.

Discussion

Trapezites genevieveae

Originally considered subspecies of *T. maheta*, Waterhouse (1912) raised both *T. iacchoides* and *T. phigalioides* to specific level following the discovery that their distributions overlapped in New South Wales. Sands *et al.* (1984) further raised *T. maheta praxedes* to specific rank after observing that both *praxedes* and *maheta* are sympatric in southern Queensland and northern New South Wales.

The type locality of *T. praxedes* is regarded as Port Jackson (Sydney, NSW) (Waterhouse 1932a). It is distributed from southern Queensland (Fraser Island [pers. obs.] and Cooloola [Sands *et al.* 1984]), south through coastal New South Wales to East Gippsland, Victoria (Common and Waterhouse 1981). A specimen listed by Dunn and Dunn (1991, '50 km S of Sarina') in M. De Baar collection is in fact a female *T. maheta* (pers. obs.). The type locality of *T. maheta* is Brisbane, Queensland (Waterhouse 1937) and this taxon occurs from northern New South Wales to northern Queensland (Dunn and Dunn 1991).

T. genevieveae taxonomically is closely allied to and not easily distinguished from *T. praxedes* unless the comparative adult specimens are fresh and unworn. The fore and hindwings of both sexes are slightly more distally pointed than those of *T. praxedes*. Southern specimens of the latter are distinctly smaller (Figs 1-2; average male forewing length = 15 mm; female = 17 mm). All specimens of *T. genevieveae* have a suffused broad area of pale yellow scales along the inner margin of the underside of the forewing, which is prominent in females but variable in extent in males. The underside of the hindwing in males possesses at least one extra silver subterminal spot (usually two or more) in the apical area, but in *T. praxedes* males these subterminal spots are diffused black, rarely centred with a few silver scales. The row of dark subterminal spots on the underside of the hindwing in females are often centred with white scales; these are never so in *T. praxedes*, the females of which have these spots centred dull grey. In both sexes of *T. genevieveae* the general ground scaling of the underside of the wings is various shades of brown and purplish-brown; in *T. praxedes* it is shades of dark grey or pure-grey (the latter colour especially in northern specimens [Fig. 11]).

The males of both species differ from *T. maheta* (Fig. 5) by the shape of the wings and the size, shape and position of the silver spots. Both sexes of *T. maheta* have only a slight suffused pale yellow inner margin on the underside of the forewing and the females (Fig. 6) lack the white-centred spots of the

undersides. Both sexes of *T. maheta* have stout bodies and shorter, more rounded wings and a more yellowish-grey appearance on the underside.

Larvae and pupae of *T. genevieveae* are paler than that of the two comparative species, neither of which have a larval diapause and are multivoltine in areas of sympatry. Larvae feed from 21h00 to 24h00 (EST).

T. praxedes is found in heaths, dry woodlands and open wet sclerophyll forests that support a dense heath-like ground cover. It is multivoltine, or in the southern part of its range at least bivoltine, flying throughout the warmer months, particularly during spring and autumn. By contrast, adults *of T. genevieveae* are found only in rainforest in mid-summer. The foodplants of *T. praxedes* are soft species of *Lomandra*, principally *L. obliqua* (Thunb.) J.F. Macbr., a generally prostrate fine-leafed creeper. *T. maheta* flies throughout the warmer months (particularly in spring and autumn) in mixed woodlands, rangeland riverine forests and Wallum heathlands. I have found larvae of this species on *L. hystrix* at Byfield, central Qld.

Probably the first specimen of *T. genevieveae* was collected in January, 1911 by R.J. Tillyard at Dorrigo, in northern NSW (Waterhouse and Lyell 1914, 1 male now in NMVM [M.F. Braby, pers. comm.]). Other specimens were collected by H. Sibatani in the summer of 1967-68 near Coffs Harbour, NSW. These specimens (presumably in Sibatani's collection) were the subject of a paper (Sibatani 1970) dealing with a curious male aberration (collected in December, 1968 and now in ANIC) found in rainforest at Bruxner Park. I have collected and reared specimens (found on *L. spicata*) from the Dorrigo area and at Bruxner Park and confirm that these are *T. genevieveae.*

T. genevieveae and *T. praxedes* are sympatric in some areas where sclerophyll woodland and rainforest meet in mid-coastal NSW and near Brisbane, Qld but appear to be temporally isolated at these sites (pers. obs.). Specimens of both species have been collected and reared within 5 km of each other in the Brisbane hinterland (see Figs 27-28). A male of typical coastal *T. praxedes* (but with aberrant genitalia) was collected recently by A.S. Smithers in the Mt Royal area of the Barrington Ranges (Atkins and Smithers 1995). This is about 10 km from populations of *T. genevieveae* at Mt Allyn. These two species are also partly sympatric with *T. maheta* in the districts of Grafton and Busby Flat, NSW and probably north to at least the Nambour area, Qld.

Morphological differences in some populations of *T. praxedes* in northern NSW (see Figs 15-16, 28-29) require further study to determine if further speciation is occurring in this complex.

Trapezites taori

The type locality of *T. symmomus* is the Sydney area (Waterhouse 1932b, 1937). The two described subspecies, *T. s. soma* and *T. s. sombra*, occur in

Victoria and north Queensland respectively. The second largest species in the genus, *T. taori* resembles both *T. eliena* and *T. symmomus* but adults and juveniles are morphologically closer to the latter species. Its swift, elevated flight resembles that of *T. iacchoides*. *T. taori* is bivoltine and appears to be restricted to the drier sandstone vegetation communities of mixed heath and woodlands of the central highlands.

T. symmomus is found in woodlands and heaths with a moderate to high rainfall. It occurs at Kroombit Tops, 130 km SW of Blackdown Tableland. It is normally univoltine (eg Kroombit Tops, Eungella Range and Atherton Tableland, Qld), flying in the warmer summer months in montane areas or in autumn in the southern coastal areas. Dunn and Dunn (1991) recorded a bivoltine brood in southern coastal Queensland and adults have been recorded in October at Broken Heads and Toormina, northern NSW (pers. obs.).

Sexual dimorphism is not obvious in adult *T. taori*. The adult is somewhat smaller than *T. symmomus* (Figs 7-8, 12), less angular in shape (especially males) and more muted in colour. The male genitalia are distinctly asymmetric (Figs 18, 21) and the lateral processes of the uncus are smaller than in *T. symmomus* (Figs 19-20). The female genitalia (Fig. 23) have a quadriform, broadly divided post-vaginalis and not a spreading V-shaped process as in *T. symmomus* (Fig. 24).

Taxonomically *T. taori* is less specialised than *T. symmomus* and links with the *phigalioides/ maheta/ praxedes/ genevieveae/ iacchoides* section of *Trapezites*.

Conservation

Trapezites genevieveae and *T. taori* are uncommon to rare species, undoubtedly having avoided previous detection by their similarity to closely related 'sister-species', their cryptic habits and specialised habitat selection.

T. genevieveae is a vulnerable 'refugia' species recorded from disjunct old-growth rainforest localities. Clear-felling of timber in these habitats outside National Parks would further isolate the species. Recent larval feeding signs on foodplants in some localities such as Nightcap Range and Tallowwood Forest indicate that the skipper is able to recolonise selectively logged areas, providing that there are corridors of dense rainforest and sufficient regrowth older than 30 years (pers. obs.). It is likely that more populations will be found within the known range (especially in the upper catchments of the Hunter, Manning, Hastings, Clarence and Richmond River systems) and perhaps further afield in Queensland.

The present known distribution of *T. taori* is extremely restricted and it appears to be rare. Isla Gorge is an exposed, dry locality and, together with Expedition Range and Springsure, is subject to intense seasonal bushfires and irregular rainfall. The species' bivoltine life cycle would probably facilitate

rapid recovery from fires and droughts provided that these are scattered or infrequent. This species may also have a wider distribution than presently known.

It is clear that more distributional and biological data are required before conservation measures are developed. All species in the genus are vulnerable to land disturbance and populations rapidly become extinct as a result of commercial and agricultural development. Existing populations of these two new skipper butterflies should be monitored closely by amateur and professional entomologists.

Acknowledgments

Initial field and research work was conducted with the help of the late J.C. and M. Le Souëf and by R. and N. Manskie (Maryborough); more recently by Dr M.F. Braby (ANIC, Canberra), M. De Baar (Brisbane), R. Eastwood (Brisbane), E. Edwards (ANIC, Canberra), Dr E. Nielsen (ANIC, Canberra), R. Mayo (Medowie) and G. Wallace (Newcastle). I am grateful for their help, support and discussion. Further recognition is due to my colleagues Prof. G. Gilchrist and C. Sanders, plus L. Ginters and D. Fraser of the Faculty of Art and Design, University of Newcastle, for their support and encouragement and to the Study Leave and Research Committees of the same Institution for their support. Finally my thanks to the National Parks Officers at Blackdown Tableland for field assistance.

References

ATKINS, A.F. 1974. Butterflies of Expedition Range, Central Queensland. *Victorian Entomologist* **4**: 9-14.

ATKINS, A.F. 1987. The life history of *Trapezites iacchoides* Waterhouse and *Trapezites phigalioides* Waterhouse (Lepidoptera: Hesperiidae: Trapezitinae). *Australian Entomological Magazine* **13**: 53-58.

ATKINS, A.F. and SMITHERS, C.N. 1995. A genitalic aberration of *Trapezites praxedes* (Hesperiidae: Trapezitinae) from New South Wales. *Australian Entomologist* **22**: 47-50

BRABY, M.F. 1994. Range extensions and distribution records for some butterflies in north-eastern Queensland. *Australian Entomologist* **22**: 109-112.

COMMON, I.F.B. and WATERHOUSE, D.F. 1981. *Butterflies of Australia*. Angus and Robertson, Sydney; xiv+662 pp.

DUNN, K.L. and DUNN, L.E. 1991. *Review of Australian Butterflies: distribution, life history and taxonomy*. Part 2, Family Hesperiidae. Privately published, Melbourne.

LEE, A.T. and MACFARLANE, T.D. 1986. *Lomandra*. Ch. 5, in: *Flora of Australia* **46**: 100-141.

LE SOUËF, J.C. 1975. New butterfly records for Springsure, Central Highlands, Queensland. *Australian Entomological Magazine* **2**: 97.

MAYO, R. and ATKINS, A.F. 1992. *Anisyntoides* Waterhouse (Lepidoptera: Hesperiidae): a synonym of *Trapezites* Hübner, with description of a new species from Western Australia. *Australian Entomological Magazine* **19**: 81-88.

SANDS, D.P.A., MILLER, C.G., KERR, J.F.R. and ATKINS, A.F. 1984. The specific status of *Trapezites praxedes* (Plötz) (Lepidoptera: Hesperiidae): previously considered to be *T. maheta* (Hewitson). *Australian Entomological Magazine* **11**: 27-33.

SIBATANI, A. 1970. An aberrant form of *Trapezites maheta praxedes* (Plötz) (Lepidoptera: Hesperiidae) from New South Wales. *Journal of the Australian Entomological Society* **9**: 67-68.

VALENTINE, P. 1988. *Australian Tropical Butterflies*. Tropical Australian Graphics, Paluma; 71pp.

WATERHOUSE, G.A. 1912. Descriptions of and notes on some Australian Hesperidae (sic). *Victorian Naturalist* **28**: 223-228.

WATERHOUSE, G.A. 1932a. Australian Hesperiidae. II. Notes and descriptions of new forms. *Proceedings of the Linnean Society of New South Wales* **1552**: 220.

WATERHOUSE, G.A. 1932b. Australian Hesperiidae. III. Descriptions of new forms. *Proceedings of the Linnean Society of New South Wales* **1552**: 409.

WATERHOUSE, G.A. 1937. Australian Hesperiidae. VII. Notes on the types and type localities. *Proceedings of the Linnean Society of New South Wales* **2012**: 108-125.

WATERHOUSE, G.A. and LYELL, G. 1914. *The Butterflies of Australia*. Angus and Robertson, Sydney; 239 pp.

WILLIAMS, M.R. and ATKINS, A.F. 1997. The life history of *Trapezites waterhousei* Mayo & Atkins (Lepidoptera: Hesperiidae: Trapezitinae). *Australian Entomologist* **24**: 1-4.

WILLIAMS, M.R., WILLIAMS, A.E. and ATKINS, A.F. 1992. The life history of the Sciron Skipper *Trapezites sciron sciron* Waterhouse and Lyell (Lepidoptera: Hesperiidae: Trapezitinae). *Australian Entomological Magazine* **19**: 29-32.

THE BUTTERFLIES (LEPIDOPTERA) OF GARDEN AND ROTTNEST ISLANDS, WESTERN AUSTRALIA

Andrew A.E. Williams

Department of Conservation and Land Management,, W.A. Wildlife Research Centre, PO Box 51, Wanneroo, WA 6065

Abstract

Fourteen species of butterflies are recorded from Garden I.: *Trapezites argenteoornatus argenteoornatus* (Hewitson), *Delias aganippe* (Donovan), *Pieris rapae rapae* (Linnaeus), *Danaus chrysippus petilia* (Stoll), *Geitoneura klugii insula* Burns, *Heteronympha merope duboulayi* (Butler), *Vanessa kershawi* (McCoy), *Vanessa itea* (Fabricius), *Junonia villida calybe* (Godart), *Jalmenus inous* Hewitson, *Candalides acastus* (Cox), *Nacaduba biocellata biocellata* (C. & R. Felder), *Theclinesthes miskini miskini* (T.P. Lucas) and *Zizina labradus labradus* (Godart). Four species are newly recorded from Rottnest I.: *Pieris r. rapae*, *Danaus c. petilia*, *Vanessa kershawi* and *Zizina l. labradus*. The butterfly faunas of Garden and Rottnest Is are compared.

Introduction

Garden I. (32°12'S 115°40'E) is located 15 km SSW of Fremantle and is separated from the mainland by Cockburn Sound. The island, which is 9.5 km long and 2 km wide at its widest point, covers an area of approximately 1100 ha. At its southern end it is separated from the mainland by 2 km, now spanned by a causeway. It is derived from Pleistocene aeolianite (Tamala Limestone) and is covered by Holocene calcareous sand dunes (Brooker *et al.* 1992). The western side is exposed to harsh ocean weathering, whereas the eastern shoreline is well sheltered.

In 1829, the first settlers in Western Australia camped on Garden I. before moving to the mainland. At that time most of Garden I. seems to have been covered with *Callitris preissii / Melaleuca lanceolata* forest but by the 1950's *Acacia rostellifera* scrub over *Acanthocarpus preissii* had become the most widespread community (Rippey and Rowland 1995). Much of the island is still dominated by this association. *Melaleuca lanceolata / Callitris preissii* forest still remains but forms a less extensive component of the vegetation. Compared with the adjacent mainland the vegetation is relatively undisturbed, with fire excluded from large areas for many years. The Department of Defence is responsible for ongoing environmental management (Brooker *et al.* 1992).

Rottnest I. (32°00'S 115°30'E) lies 20 km NW of Garden I. and 18 km off shore. It is 11 km long, almost 5 km wide at its widest point and covers an area of 1900 ha. It has greater habitat variety than Garden I., the most striking difference being the presence of salt lakes and associated vegetation (Marchant and Abbott 1981). Ten species of butterfly have been recorded previously on Rottnest I. (Common and Waterhouse 1981, Dunn and Dunn 1991, Rippey and Rowland 1995).

Between January 1995 and May 1996 Garden I. was visited on a monthly basis and regular opportunistic observations made on the lepidopteran fauna during that time. Observations were made on a visit to Rottnest I. in November 1995. Voucher specimens are lodged in the Insect Collection of the Western Australian Department of Conservation and Land Management.

Table 1. Butterflies recorded from Garden and Rottnest Islands.

FAMILY	SPECIES	GARDEN	ROTTNEST
Hesperiidae	*Trapezites s. sciron*		•
	T. a. argenteoornatus	•*	•
	Anisynta sphenosema		•
	Hesperilla donnysa albina		•
	H. c. chrysotricha		•
Pieridae	*Delias aganippe*	•*	
	Pieris r. rapae	•*	•*
Nymphalidae	*Danaus p. plexippus*		•
	D. chrysippus petilia	•*	•*
	Geitoneura klugii insula	•*	•
	Heteronympha merope duboulayi	•*	
	Vanessa kershawi	•*	•*
	V. cardui		•
	V. itea	•*	•
	Junonia villida	•*	
Lycaenidae	*Jalmenus inous*	•*	
	Candalides acastus	•*	
	Nacaduba biocellata	•*	
	Theclinesthes m. miskini	•*	
	T. s. serpentata		•
	Zizina l. labradus	•*	•*
TOTALS	21	14	14

Note:- * = new record.

Observations on Garden Island

Species recorded on Garden I. are listed in Table 1.

HESPERIIDAE

Trapezites argenteoornatus argenteoornatus (Hewitson). Very common; adults first seen in early October but most abundant in November, with small numbers still present towards the end of December. Adults visited the flowers of *Senecio lautus*, *Trachymene coerulea*, *Asphodelus fistulosus*, *Scaevola crassifolia* and the introduced thistle *Carduus pycnocephalus*. Larvae were found on *Acanthocarpus preissii*. A fresh egg matched the description by Common and Waterhouse (1981) but was cream-white in colour. The ovum measured 1.0 mm in diameter, the first instar larva 2.5

mm in length. Its head is large and rounded, shiny black and finely pitted, with a few minute whitish hairs; the wide prothoracic plate is brownish-black and shiny. The body is cream, with indistinct reddish-brown dorsal and lateral stripes, becoming more pronounced towards the posterior end. The posterior segment had sparse long whitish setae.

PIERIDAE

Delias aganippe (Donovan). Generally uncommon; adults were observed from mid January to late April. Individuals were most frequently seen in *Melaleuca lanceolata* woodlands or circling high points at the northern end of the island. Grund (1996) recently recorded the mistletoe *Amyema melaleucae* (a parasite on *M. lanceolata*) as a larval foodplant; this may well explain the presence of *D. aganippe* on Garden I.

Pieris rapae rapae (Linnaeus). This may not be an established resident; one specimen was collected near Point Atwick firebreak in October 1995 and occasional specimens observed in November and December, near beaches at the northern end of the island. It is very common in the south-west of Western Australia wherever brassicas are grown and was first recorded in Perth in 1943 (Houston 1994).

NYMPHALIDAE

Danaus chrysippus petilia (Stoll). In February 1995 Cyclone Bobby brought widespread heavy rainfall across much of inland Western Australia. This preceded a massive buildup of butterflies on the mainland during March and April 1995 (Williams *et al.* 1996). On Garden I. numbers were very low in February but increased markedly during April and May. Between June 1995 and May 1996 no further individuals were seen.

Geitoneura klugii insula Burns. Abundant during spring and early summer 1995. Males appeared in late October, females in the second week of November. By mid December only females were seen. Adults were attracted to the flowers of *Trachymene coerulea, Carduus pycnocephalus* and *Scaevola crassifolia*. The larval foodplant is the tussock grass *Stipa flavescens* Labill. Larvae were located in early spring near the bases of tussocks where they tended to hide during the day. Fisher (1978) noted that in South Australia larvae of *G. k. klugii* (Guérin-Méneville) feed openly during the daytime and do not hide near the base of the foodplant. Mature larvae from Garden I. differed from those described by Fisher (1978), in having a yellowish rather than red tip to the bifid anal segment. Several grasses, including *Brachypodium distachyon, Poa tenera* and *Themeda australis*, have been recorded as larval foodplants for *G. k. klugii* (Fisher 1978). On the mainland near Wanneroo, north of Perth, I have also found larvae of *G. k. klugii* on perennial veldt grass *Ehrharta calycina* Smith.

Heteronympha merope duboulayi (Butler). In February 1996, a female was collected in open *Melaleuca lanceolata/Acacia rostellifera* woodland habitat

close to Atwick firebreak. The status of this butterfly is uncertain since only one specimen was encountered.

Vanessa kershawi (McCoy). Fairly common, with adults seen from September to January.

Vanessa itea (Fabricius). In January 1995 worn specimens were seen occasionally but none was recorded after this during the very hot late summer months. A single freshly emerged individual was seen in May, near the northern end of the island. The species was very common from late August to November, numbers diminishing rapidly in December. Adults frequently hill-topped above high dunes and fed on the flowers of *Trachymene coerulea*, *Westringia dampieri* and *Carduus pycnocephalus*. Two known foodplants, *Urtica urens* (Common and Waterhouse 1981) and *Parietaria debilis* (Powell 1993), are both present on Garden I. (McArthur and Bartle 1981). A few occupied larval shelters were found on nettles in July and by late August-September large numbers of shelters were present.

Junonia villida calybe (Godart). Around Perth, this species is reported to be less abundant than it used to be, but the reasons for its decline are unknown (Houston 1994). On Garden I. in 1995 the species was common, with adults most abundant from September to December and for a shorter period in May.

LYCAENIDAE

Jalmenus inous Hewitson. Three small colonies were located, one near the helicopter support facility at the southern end of the island, one close to the main road barrier north of the armaments jetty, and a third alongside Atwick firebreak. Several adults were seen near the well at the northern end of the island, suggesting that a breeding colony may be present at this site. Adults were active from October to December, flying around young *Acacia rostellifera* shrubs, the larval foodplant. Larvae and pupae were located at the bases of these shrubs where they were always attended by small black ants of the *Iridomyrmex rufoniger* species group.

Candalides acastus (Cox). Uncommon; a freshly emerged female was collected in a sheltered swale behind beach foredunes on the western side of the island near Gilbert Point.

Nacaduba biocellata biocellata (C. & R. Felder). Relatively uncommon, but abundant for a short time in February 1995 after a series of light summer showers. An influx was encountered for a short period in May 1996. It was seldom encountered at other times of the year.

Theclinesthes miskini miskini (T.P. Lucas). The main flying time was late November and December. It was present throughout the *Acacia rostellifera* woodlands at the northern end of the island and was also seen hill-topping on Buache Hill. One specimen was collected in February.

Zizina labradus labradus (Godart). Very uncommon; one freshly emerged individual encountered close to Atwick firebreak in December 1995.

Observations on Rottnest Island

Species recorded on Rottnest I. are listed in Table 1. All observations were made during November, 1995.

HESPERIIDAE

Trapezites argenteoornatus argenteoornatus (Hewitson). Recorded from September to December by Common and Waterhouse (1981). Abundant wherever the foodplant *Acanthocarpus preissii* was present, with adults attracted to the flowers of *Scaevola crassifolia.*

PIERIDAE

Pieris rapae rapae (Linnaeus). Not previously recorded; observed feeding on flowering *Scaevola crassifolia* shrubs alongside Garden Lake.

NYMPHALIDAE

Danaus chrysippus petilia (Stoll). Not seen; one individual was observed on the island in April 1995 (Vanda Longman, *pers. comm.*).

Danaus plexippus plexippus (Linnaeus). Several individuals were noted, most found in sheltered areas planted with *Eucalyptus gomphocephala.*

Geitoneura klugii insula Burns. Abundant, with large numbers feeding on the flowers of *Trachymene coerulea* and *Scaevola crassifolia. Stipa flavescens*, the larval foodplant on Garden I., is also widespread on Rottnest.

Vanessa kershawi (McCoy). A single specimen, tentatively identified as this species, was observed but not collected near Garden Lake.

LYCAENIDAE

Theclinesthes serpentata serpentata (Herrich-Schaffer). Moderately common around margin of the salt lakes, with most individuals seen in areas sheltered from the wind.

Zizina labradus labradus (Godart). Several specimens were collected at the western end of the island, flying over low shrub ground-cover in sheltered swales and hollows.

Discussion

Although Garden I. is relatively close to the mainland and is one of the most closely studied islands in Western Australia, nothing has been published previously on its butterfly fauna. Paradoxically, the lepidopteran fauna of Rottnest I. is comparatively well known, even though it lies considerably further (18 km) from the coast. Fourteen butterfly species are recorded from Garden I., the same number are known from Rottnest.

The similarity in overall butterfly species numbers for Rottnest and Garden Is is interesting given that Rottnest is some 600 ha larger than Garden

(excluding salt lakes), and has greater habitat diversity (Marchant and Abbott 1981). This similarity is also reflected in the native plant species occurring on the two islands, with Rottnest having only two species more than Garden I. Rottnest has 105 and Garden 103 species of native plants, 40 of these common to both islands (Marchant and Abbott 1981).

The species composition of Rottnest and Garden I. butterflies provides some interesting anomalies (Table 1). A combined total of 21 species has been recorded but only seven are common to both islands: *T. a. argenteoornatus*, *P. r. rapae*, *D. c. petilia*, *G. k. insula*, *V. kershawi*, *V. itea* and *Z. l. labradus*.

HESPERIIDAE

Only one Skipper, *T. a. argenteoornatus*, was recorded on Garden I. This contrasts with Rottnest where five species have been recorded (Common and Waterhouse 1981, Dunn and Dunn 1991). Two of these, *Hesperilla donnysa albina* Waterhouse and *Hesperilla chrysotricha chrysotricha* (Meyrick & Lower), both require *Gahnia* species on which to breed. No gahnias have been recorded from Garden I. *Trapezites sciron sciron* Waterhouse & Lyell is also known from Rottnest, although no recent specimens have been collected. *Anisynta sphenosema* (Meyrick & Lower) is also recorded from Rottnest but was not encountered on Garden I. during the 1995/96 survey.

LYCAENIDAE

Lycaenids are better represented on Garden I. (5 spp.) than on Rottnest (2 spp.). Only one, *Z. l. labradus*, was common to both. On Rottnest I. only *T. s. serpentata* (Herrich-Schaffer) had been recorded previously (Williams *et al.* 1993). It flies near the salt lakes where the saltbush *Atriplex cinerea* is almost certainly the foodplant. This habitat is absent from Garden I. In November 1995, *Z. l. labradus* was recorded at the extreme western end of Rottnest I. On Garden I. it is uncommon.

The presence of *J. inous* on Garden I. is significant because it represents the first known island population for this species. Specimens from Garden I. are morphologically similar to those from Singleton, a nearby mainland population which has drastically declined following clearing. In coastal areas around Perth and Mandurah and south to Bunbury, this species may be regarded as vulnerable due to increasing pressure from urban development; several local populations have been destroyed in recent years. The colonies on Garden I. therefore should be consciously protected.

Cassytha glabella is fairly plentiful on Garden I. and is a known foodplant for *C. acastus* in Queensland and South Australia (Common and Waterhouse 1981). However, despite careful searching, no sign of any *Candalides* species was found until March 1996, when a freshly emerged female *C. acastus* was taken on the western side of the island. Around Perth, *C. acastus* flies in spring and early summer; its appearance on Garden I. at the beginning of autumn is surprising and further investigation is needed to

confirm whether mainland and island populations fly at different times of the year. No *Ogyris* species was encountered either on Garden or Rottnest Is, although a mistletoe, *Amyema melaleucae*, is known from Garden I. (McArthur and Bartle 1981) and this could be a suitable foodplant for *Ogyris amaryllis meridionalis* Bethune-Baker. On exposed limestone surfaces along the western side of Garden I., *Leptomeria preissiana*, a known foodplant of *Ogyris otanes* C. & R. Felder, is fairly plentiful but the *Camponotus* ant species required by its larvae was not present.

PIERIDAE

The whites *D. aganippe* and *P. r. rapae* are both recorded from Garden I. On Rottnest I. *P. r. rapae* was observed on flowering *Scaevola crassifolia* near Garden Lake in November 1995. The species had been seen previously on Rottnest and has probably become established there around the main settlement (R.J. Powell, *pers. comm.*).

NYMPHALIDAE

Nymphalid butterflies are present on both islands and the assemblages are very similar. On Rottnest a vagrant *D. c. petilia* was seen in April 1995 (Vanda Longman, *pers. comm.*). At that time the species was particularly abundant on the mainland and Garden I. *D. p. plexippus* was not seen on Garden I. in 1995/96, but is an established resident on Rottnest where it breeds on the introduced *Gomphocarpus fruiticosus* (Rippey and Rowland 1995). It has been seen or collected on a number of occasions during spring and summer.

G. k. insula is abundant on both Garden and Rottnest Is. Dunn and Dunn (1991) have pointed out that some *G. k. klugii* specimens from coastal Western Australia are similar in appearance to *G. k. insula* and suggest that a reappraisal of the status of *G. k. insula* may be needed. Specimens of *G. klugii* from Garden I. are indistinguishable from *G. k. insula* from Rottnest and are assigned to that subspecies. It would be interesting to know whether mature *G. k. insula* larvae from Rottnest I. and *G. k. klugii* larvae from mainland Western Australia have a yellowish bifid anal segment similar to the Garden I. larvae, or a red tipped bifid anal segment as described by Fisher (1978) for South Australian *G. k. klugii*. *H. m. duboulayi* was not seen on Garden I. during 1995 but one worn female was collected in March 1996, possibly a vagrant from the mainland.

V. kershawi is fairly common on Garden I. and is also resident on Rottnest where it apparently occurs only in low numbers (R.J. Powell, *pers. comm.*). Although *J. v. calybe* is very common on Garden I., it appears to be absent from Rottnest. This species is a strong flier and known migrant and could likely fly to Rottnest Island from the mainland. It is established on Bernier Island, 50 km west of Carnarvon (Williams and Hall 1993). *V. itea* is common on both Rottnest and Garden Is where the same foodplants are available. *Vanessa cardui* (Linnaeus) has been recorded from Rottnest I.

(Common and Waterhouse 1981) but has not been observed there for several years.

Acknowledgments

I am grateful to the Department of Defence for allowing access to Garden I. I thank Robert Powell of the Department of Conservation and Land Management for information obtained on visits to both islands. Steve Shattuck, CSIRO, Canberra, identified the *Iridomyrmex* ants from Garden Island.

References

BROOKER, M., SMITH, G., INGRAM, J., LEONE, J., SAUNDERS, D. and DE REBEIRA, P. 1992. *Biological Survey Garden Island.* CSIRO Division of Wildlife and Ecology, Perth, Western Australia.

COMMON, I.F.B. and WATERHOUSE, D.F. 1981. *Butterflies of Australia*: Pp. xiv + 682. Angus and Robertson, Sydney.

DUNN, K.L. and DUNN, L.E. 1991. *Review of Australian Butterflies: distribution, life history and taxonomy.* Pp. 1-660. Privately published, Melbourne.

FISHER, R.H. 1978. *Butterflies of South Australia.* Government Printer, South Australia.

GRUND, R. 1996. Range extensions, new foodplant recordings and biology for some South Australian butterflies. *Victorian Entomologist* **26**: 93-100.

HOUSTON, T.F. (ed) 1994. *Bring Back the Butterflies: Butterfly Gardening for Western Australians.* W.A. Museum, Perth.

MARCHANT, N.G. and ABBOTT, I. 1981. Historical and recent observations of the flora of Garden Island, Western Australia. *Western Australian Herbarium Research Notes* **5**: 49-62.

McARTHUR, W.M. and BARTLE, G.A. 1981. *The landforms, soils and vegetation as a basis for management studies on Garden Island, Western Australia.* Land Resources Management Series No.7. CSIRO: Melbourne.

POWELL, R.J. 1993. The use of two species of *Parietaria* (Urticaceae) as foodplants by the butterfly *Vanessa itea* (Fabricius) in south-western Australia. *Australian Entomologist* **20:** 57-58.

RIPPEY, E. and ROWLAND, B. 1995. *Plants of the Perth Coast and Islands.* University of Western Australia Press, Nedlands, Western Australia.

WILLIAMS, A.A.E. and HALL, G.P. 1993. New records of butterflies (Lepidoptera: Hesperioidea and Papilionoidea) from Bernier Island, Western Australia. *Australian Entomologist* **20:** 45-46.

WILLIAMS, A.A.E., WILLIAMS, M.R., HAY, R.W. and TOMLINSON, A.G. 1993. Some distributional records and natural history notes on butterflies from Western Australia. *Victorian Entomologist* **23:** 126-131.

WILLIAMS, A.A.E., WILLIAMS, M.R., TOMLINSON, A.G. and LUNDSTROM, T.D. 1996. Records of butterflies from the central desert region and semi-arid areas of Western Australia. *Victorian Entomologist* **26:** 29-34.

ECOLOGICAL OBSERVATIONS AND NOTES ON THE LIFE HISTORY OF *PHILIRIS DIANA PAPUANA* WIND & CLENCH (LEPIDOPTERA: LYCAENIDAE)

P.S. VALENTINE[1] and S.J. JOHNSON[2]

[1] *Tropical Environment Studies and Geography, James Cook University, Townsville, Qld 4811*
[2] *Oonoonba Veterinary Laboratory, PO Box 1085, Townsville, Qld 4810*

Abstract

The primary larval food plant of *Philiris diana papuana* Wind & Clench is *Litsea breviumbellata* C.K. Allen. Observations are recorded on the close adaptation of the butterfly larvae and pupae to the features of this plant. *L. breviumbellata* is recorded also as a larval food plant for *Philiris fulgens kurandae* Waterhouse and *Chaetocneme critomedia sphinterifera* (Fruhstorfer) (Hesperiidae).

Introduction

Philiris diana papuana Wind & Clench, a species not well represented in collections, has been recorded from Cape York to Claudie River (Common and Waterhouse 1981). In recent years we have reared many individuals from Heathlands, several locations in the Iron Range area and from the Rocky River and Chester River area on Silver Plains Station (new southern limit for this subspecies). These records show the species to be widespread and at times abundant. Wood (1984) first described the life history from Iron Range and listed *Litsea leefeana* (F. Muell.) Merr. (Lauraceae) as the larval food plant, while Johnson (1993) first recorded *Litsea breviumbellata* C.K. Allen as a larval food plant.

Observations and Discussion

In our experience, which includes the location of juvenile stages of *P. d. papuana* on more than 100 individual plants at numerous locations, *L. breviumbellata* is always used. Further, the life history behaviour supports the contention that this species is the primary larval food plant. Early instar larvae are yellow and orange and rest adjacent to veins beneath older leaves which are rusty golden yellowish on the underside. In later instars the humped larvae become deep reddish and rest on the upper surface of the terminal buds or very young leaves, sometimes on the swollen petioles of the leaves. In *L. breviumbellata* the juvenile foliage and petioles are rich rusty red and *P. d. papuana* larvae are highly cryptic when resting on these. The final larval instar and pupa are striped and, unlike other known Australian *Philiris* spp., the pupa is fully exposed on the central vein at the base of the upper surface of a juvenile leaf (see Wood 1984). In this situation the pupa has excellent cryptic coloration on *L. breviumbellata*, indicating a strong adaptation between the juvenile stages of *P.d. papuana* and this plant.

The record of *L. leefeana* by Wood (1984) raises interesting questions. The juvenile leaves, which are green, do not provide the same opportunity for disguise and we believe it is unlikely that *L. leefeana* would be used if *L. breviumbellata* was available. Although we have not found larvae of *P. d.*

papuana on *L. leefeana* in the wild, we have placed larvae on potted plants of this species and found that they are reluctant to feed compared with larvae on *L. breviumbellata*. If confined to *L. leefeana*, larvae grow more slowly and are less likely to reach full size. In addition, in all locations where we have found *P. d. papuana* we have found *L. breviumbellata* to be abundant, whereas *L. leefeana* appears to be rare or absent.

The ecological niche occupied by *P. d. papuana*, in our experience, is the ecotone between rainforest or swampland and open sclerophyll woodland. This environment is subject to periodic fires and the groves and patches of *L. breviumbellata* regenerate from suckers or seedlings to provide ideal resources for larval *P. d. papuana*. At times we have found large numbers of juvenile stages on such regrowth patches, usually not more than one or two per plant but once as many as six larvae on a small plant. The larvae of *P. fulgens kurandae* Waterhouse, at least in the Iron Range area, also occasionally use *L. breviumbellata* but they rest and feed on the older leaves only. In our experience in the Innisfail area, *P. fulgens* prefers to use *Cryptocarya mackinnoniana* F. Muell. (Lauraceae) as a larval food plant. Early instar larvae of both species often rest under leaves near the base of small plants.

The hesperiid *Chaetocneme critomedia sphinterifera* (Fruhstorfer) also uses *L. breviumbellata* as a larval food plant and we have found larvae at Heathlands, widely in the Iron Range area and in the Rocky River area.

Acknowledgments

We thank the Queensland Herbarium for the identification of *Litsea breviumbellata* and the Queensland Department of Environment for permits covering areas of National Park included in our studies.

References

COMMON, I.F.B. and WATERHOUSE, D.F. 1981 *Butterflies of Australia*. Second Edition, Angus and Robertson, Sydney, 682 pp.

JOHNSON, S.J. 1993 Butterfly records of interest from northern Australia. *Australian Entomologist* **20**(2): 75-76

WOOD, G.A. 1984 The early stages of *Philiris fulgens kurandae* Waterhouse and *Philiris diana papuana* Wind and Clench (Lepidoptera: Lycaenidae). *Australian Entomological Magazine* **10**(6): 81-83.

AN INTERESTING LOCAL FORM AND NEW LARVAL HOSTPLANT OF *HYPOCHRYSOPS BYZOS* (BOISDUVAL) (LEPIDOPTERA: LYCAENIDAE)

Rod Eastwood

50 Broadwater Terrace, Redland Bay, Qld 4165

Abstract

Mt Warning in northern New South Wales is recorded as a new locality for *Hypochrysops byzos byzos* (Boisduval) and a new larval hostplant, *Astrotricha longifolia* Benth. (Araliaceae) is identified.

Introduction

Hypochrysops byzos (Boisduval) occurs in south-eastern Australia from central Victoria to the A.C.T., north through New South Wales to Armidale and at Stanthorpe and "Cunnamulla" in Queensland (Common and Waterhouse 1981). More recently it has been found at Mt Moffatt in Central Queensland (Monteith and Yeates 1988). The larva of this species has been recorded feeding only on various species of *Pomaderris* (Rhamnaceae). Two subspecies are recognised; *H. byzos hecalius* Miskin from Victoria north to the A.C.T. and *H. byzos byzos* (Boisduval) in the northern part of the range.

Observations

During a hike to the summit of Mt Warning in late January 1988, females of the cryptic lycaenid *Hypochrysops byzos* were observed resting on and flying around an unidentified plant. On examining the under surface of the leaves a number of small larvae were discovered and recognised as being those of *H. byzos*. Subsequent visits to the same locality were made to obtain early stages of the lycaenid and plant material for identification. From this material a series of adults was bred which showed consistent differences from the nominate race.

H. byzos females from Mt Warning consistently lack the central yellow patch on the hindwing upperside, giving them a darker appearance than the nominate race, whilst the male ground colour beneath is greyer than specimens from Sydney. Mt Warning specimens were also compared with a series from Glen Aplin, near Stanthorpe, in the University of Queensland Insect Collection and in private collections. Glen Aplin specimens were found to be very variable. However, *H. byzos* males from Glen Aplin were almost indistinguishable from those of Mt Warning, while some of the females from Glen Aplin have a reduced spot on the hindwing upperside, approaching the form from Mt Warning (see also Sands 1986). Two female specimens from Mt Moffatt, in the Queensland Museum, were also examined and found to have hindwing spots consistent with specimens from Sydney. It would seem that the population of *H. byzos* from Mt Warning represents a clinal extreme (Fig. 1).

The hostplant was identified at the Queensland Herbarium as *Astrotricha longifolia* Benth. (Araliaceae), which grows into a short spreading tree on the upper slopes of Mt Warning, often in rather inaccessible positions. This plant family has not been recorded previously as a host for *H. byzos*. *A. longifolia* is locally abundant in the Mt Warning National Park and since the butterfly is also known from nearby Mt Chincogan (L. Matthews, pers. comm.) it would seem that the population is secure.

Fig. 1. *Hypochrysops byzos byzos* female from Mt Warning, NSW.

Acknowledgments

Lycaenid early stages and plant material were collected under NSW National Parks licence number A2004. A.R. Bean, Queensland Herbarium, Dept. of Environment, identified the hostplant. Greg Daniels, University of Queensland Insect Collection and Chris Burwell of the Queensland Museum, provided access to specimens in their care.

References

COMMON, I.F.B. and WATERHOUSE, D.F. 1981. *Butterflies of Australia*. Pp. xiv + 682. Angus and Robertson, Sydney.

MONTEITH, G.B. and YEATES, D.K. 1988. The Butterflies of Mount Moffatt and Carnarvon National Parks, Queensland. *Queensland Naturalist* **28** (5-6): 14-22.

SANDS, D.P.A. 1986. A Revision of the Genus *Hypochrysops* C. & R. Felder (Lepidoptera: Lycaenidae). *Entomonograph* **7**: 1-116.

A SAWFLY LARVA FEEDING ON AN AQUATIC FERN (HYMENOPTERA: SYMPHYTA: PERGIDAE)

I.D. NAUMANN[1] and J.K. BALCIUNAS[2]

[1] *CSIRO Division of Entomology, GPO Box 1700, Canberra, ACT 2601*
[2] *United States Department of Agriculture, Australian Biological Control Laboratory, Kevin Stark Research Building, James Cook University, Townsville, Qld 4811*
(Present address: United States Department of Agriculture, Biological Control of Western Weeds Quarantine Unit, Albany, California, U.S.A. 94710)

Abstract

Larvae of *Warra froggatti* (Rohwer) (Pergidae: Euryinae) are described and recorded feeding externally on emergent fronds of a species of the aquatic fern, *Marsilea* (Marsileaceae). For the first time a morphological diagnosis for larvae of Euryinae is proposed. The biology of *W. froggatti* is compared with that of other Symphyta.

Introduction

Life histories are known for remarkably few Australian sawflies. Generally, biological observations have been made on only one or two species for each of the subfamilies Perginae, Euryinae, Pterygophorinae, Phylacteophaginae, Philomastiginae and Pteryperginae, whilst nothing is known of the Styracotechyinae and Pergulinae (Macdonald and Ohmart 1993). In this paper we present notes on the life history of the euryine sawfly *Warra froggatti* (Rohwer). Previously nothing was known of the biology of this species. Surprisingly for a pergid, its larvae feed on the emergent foliage of a tiny aquatic fern of the genus *Marsilea* (Fig. 1).

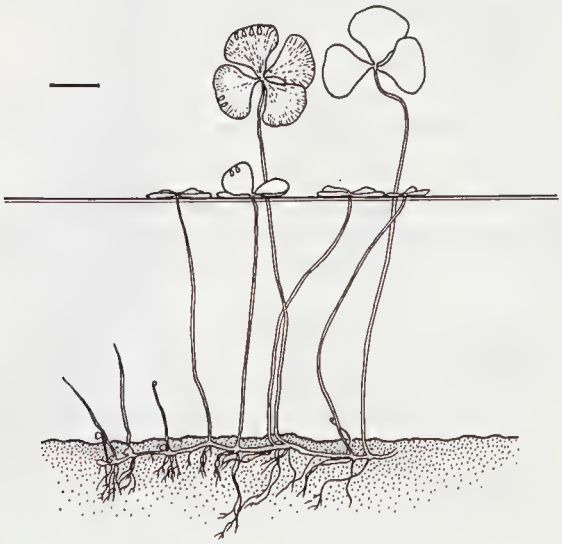


Fig. 1. Aquatic fern, *Marsilea* sp., showing *Warra froggatti* oviposition sites on frondlets. Scale line = 10 mm.

Warra froggatti was originally described in the genus *Clarissa* Kirby, from specimens collected by W. W. Froggatt in north-eastern New South Wales (Rohwer 1922). Subsequently, Benson (1934) proposed the genus *Warra* for *froggatti* and another species, *Clarissa anomocera* Rohwer, also from northern New South Wales. The literature concerning the genus has been catalogued by Smith (1978). The host plant of *W. froggatti* was mentioned by Naumann (1991) and Macdonald and Ohmart (1993), based on the observations detailed below.

In this paper we describe the external morphology of *W. froggatti* larvae, compare this with the morphology of the only other known euryine larva (that of *Polyclonus atratus* Kirby) and suggest a diagnosis for euryine larvae generally. Such a diagnosis has not previously been attempted by any author. The biology of *W. froggatti* is compared with that of *P. atratus* (reported by Moore 1957), several other euryine species (data from Naumann in press and unpublished) and Pergidae and Symphyta in general.

Methods and terminology

Adults and larvae were observed in the field and also in 28 ml, clear plastic vials. Representatives of all instars were preserved in 80% ethanol for morphological studies. The only preserved representative of the prepupal instar is a pharate individual; the prepupal mandibular dentition is clearly visible in this specimen but no other aspects of the prepupal morphology can be reported reliably. Adults and larvae are lodged in the Australian National Insect Collection, CSIRO, Canberra (ANIC). Terminology for larval morphology follows Smith and Middlekauff (1987).

External morphology of larvae of *Warra froggatti*

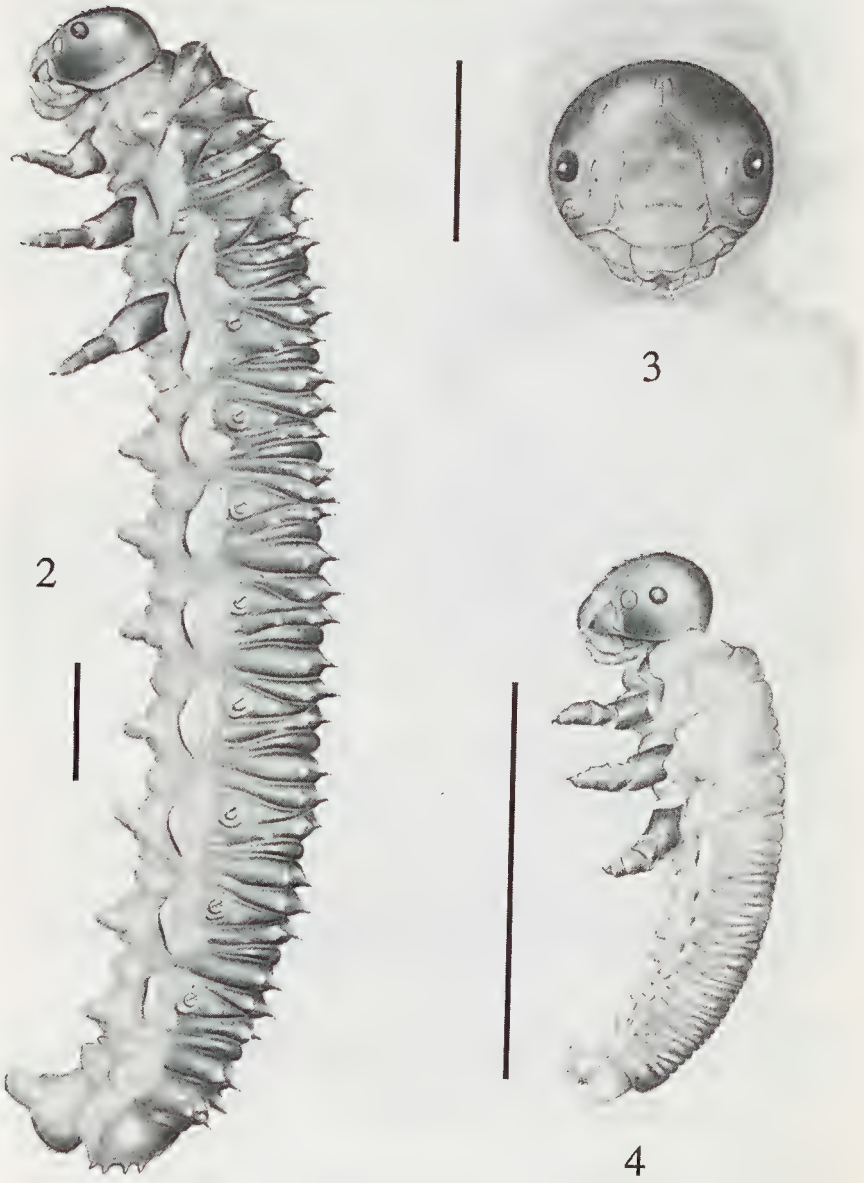
Description of third instar larva

Measurements. Total length (including head) 10-16 mm. Head width approximately 1.2 mm.

Colour. Live specimens: Head black. Thorax and abdomen lime-green. *Alcohol-preserved specimens*: Tips of mandible and tarsal claws dark brown. Head yellow-brown. Thorax and abdomen dorsally pale yellow, ventrally cream.

Microsculpture. Head smooth, thorax and abdomen very finely reticulate.

Head. Head sparsely setose (Figs 2-3), vertex bare, face with only a few scattered setae; length of setae less than maximum diameter of ocularium. Epicranial suture present. Stemma pigmented; diameter of ocularium greater than distance between ocularium and antennarium; ocularium slightly larger than antennarium. Antenna dome shaped, comprising 3-5 separate sclerites (posterior 2 sclerites discrete, anterior 3 very close to each other and appearing contiguous or fused); minimum (vertical) diameter of antennarium 1.2-1.3 times distance between antennarium and oral margin. Clypeus with transverse row of 2 setae. Labrum deeply bilobed, with transverse row of



Figs 2-4. Larvae of *Warra froggatti*: (2) third instar, lateral view; (3) head of third instar, frontal view; (4) first instar, lateral view. Scale lines = 1.0 mm.

4 or 5 setae. Mandibles asymmetrical; right mandible with 4 teeth, uppermost rounded and short, second acuminate and short, lower pair acuminate and long; left mandible with 5 teeth, uppermost rounded and short, second acuminate and short, third acuminate and long, fourth and fifth acuminate and progressively shorter. Palpal formula 5-3.

Thorax. Prothorax with single annulet, slightly overhanging posterior of head; annulet weakly bilobed, each lobe with 6-7 prominent tubercles; each tubercle with tiny, apical seta; seta shorter than tubercle. Prothoracic lateral process with 4 setose tubercles. Mesothorax with 4 annulets; first annulet with 1-2 subdorsal, setose tubercles; second annulet with 1-2 subdorsal and 2-3 dorsolateral-lateral tubercles; third annulet with 1 subdorsal and 3-4 dorsolateral-lateral tubercles; fourth annulet without tubercles. Mesothoracic lateral process with about 4 setose tubercles. Metathorax as for mesothorax. Supra-pedal processes absent. Legs each with coxa, trochanter, femur, tibia, tarsus and tarsal claw. Empodium shorter than claw.

Abdomen. Segments 1-9 each with 4 annulets; first and second annulets each with 1-2 subdorsal tubercles, 1 dorsolateral; third annulet with 1 subdorsal, 3-4 dorsolateral-laterals; fourth annulet without tubercles. Lateral processes of segments 2-9 each with about 4 tubercles. Suranal plate rectangular, lateral margin with 4-5 tubercles, posterior margin with 2-3. Segments 2-8 each with pair of widely separated prolegs, these sparsely setose, apically bare and membranous, appearing 2-segmented in some inflated specimens. Segment 10 with pair of medially contiguous prolegs, these much larger than those on preceding segments.

Description of second instar larva

As for third instar except total length approximately 9 mm, head width approximately 0.7 mm.

Description of first instar larva

As for third instar except total length approximately 1.4 mm, head width approximately 0.4 mm, head and thoracic legs much larger relative to rest of body; annulets less conspicuous; setigerous tubercles absent (Fig. 4).

Description of prepupa

Mandibles symmetrical with 4 teeth; uppermost rounded and short, second acuminate and short, third acuminate and long, lowermost acuminate and short.

Discussion

Few larvae of euryine sawflies are known. Moore (1957) described the immature stages of *Polyclonus atratus* Kirby and Naumann (in press) a larva presumed to be that of a species of *Clarissa*. Tillyard (1926) published a biological note on larvae of a species of *Diphamorphos* Rohwer but

unfortunately he did not describe the larvae and no specimens appear to have been preserved. The mature larvae of *P. atratus* and *W. froggatti* share the following features which also serve to distinguish them from the known larvae of other subfamilies of Pergidae:

> prothoracic annulet forming a 'hood' which slightly overhangs posterior of head; mesothorax, metathorax and most abdominal segments subdivided into 4 annulets; annulets with numerous setigerous tubercles; lateral processes present on most thoracic and abdominal segments; thoracic legs present, 5-segmented; abdominal segment 9 without elongate processes; suranal plate with peripheral setose tubercles, not forming elongate processes; abdominal segments 2-8 each with pair of prolegs; abdominal segment 10 with pair of prolegs or proleg-like structures.

The first author (IDN) has examined another six unassociated sawfly larvae (specimens in ANIC) which also exhibit all of these features. These unassociated larvae probably will prove to be the immatures of other species of euryine Pergidae. They differ amongst each other and from larvae attributed to *P. atratus*, *W. froggatti* and *Clarissa* in colour, microsculpture, development of the antenna, proximity of the ocularium and antennarium, mandibular shape and dentition, distribution of setigerous tubercles and shape of the suranal plate.

Biology

Notes on life cycle

The host plant for larvae of *W. froggatti* is a species of the aquatic and semi-aquatic fern *Marsilea* (Marsileaceae). The species cannot be determined conclusively but is probably *Marsilea drummondii* A. Braun. Commonly known as Nardoo, this fern grows in the shallows of fresh water pools and slow-flowing streams throughout mainland Australia. It favours areas subject to periodic inundation and is a common plant in parts of the inland and the north. It has a slender rhizome and fine roots which grow down into the mud (Fig. 1). Long pedicels arise from the rhizomes and grow upwards to the water surface. Fronds have 2 opposite pairs of frondlets which are radially arranged and generally float on the water surface. Commonly, when a frond floats on the water surface, one or more frondlets are raised slightly above the water. If the water surface becomes covered with frondlets, the fronds may stand erect with all frondlets well above the water (Leach and Osborne 1985, Williams 1980).

During this study *Marsilea* was examined at three localities near Townsville, Queensland (Alice River, Keebottom Creek, Bhole River) but *W. froggatti* was observed only at Alice River. Larvae and adults were recorded between April and May. Adults of *W. froggatti* have also been recorded from only two other localities: Ayr, approximately 110 km south east of Townsville (in

October) and the Warrah district, in north-eastern New South Wales (from October to December) (Rohwer 1922, Naumann unpublished).

Oviposition was observed in the laboratory and in the field. The typical oviposition site is between the upper and lower epidermis of the frondlet about 3 mm from the edge (Fig. 1). Usually 1-3 eggs are inserted in a frondlet, but up to 7 eggs have been recorded in a single batch. Oviposition takes place only on frondlets raised above the water surface. Eggs hatch after one to three days. Larvae feed during the day on the dorsal surface of frondlets.

Three instars were observed in the field, which is consistent with the two moults and two sets of exuviae observed in the laboratory. Larvae moult from the first to the second instar five days after hatching and from the second to the third instar two to three days later. The third instar feeds for four days before burrowing into moist soil at the edge of the water. The moult to the prepupa and pupation occurs in the soil. Adults emerged 7-9 days after the the final instar larvae entered the soil. Adults were not observed to feed in the laboratory.

Discussion

As far as is known, *W. froggatti* is unique among Pergidae and Australian sawflies in having a fern as the larval food plant.

There are about 180 species of Symphyta recorded from Australia and about 140 of these belong to the family Pergidae (Naumann 1991). Published records suggest that, at least in Australia, larvae of this family are predominantly associated with the foliage of myrtaceous plants (Macdonald and Ohmart 1993). Of the pergid subfamilies for which biological data are available, Perginae are well known on *Eucalyptus*, *Angophora*, *Syncarpia*, *Rhodamnia* and *Melaleuca*, Pterygophorinae feed on species of *Eucalyptus*, *Melaleuca*, *Callistemon* and *Leptospermum*, Phylacteophaginae feed on *Eucalyptus* and *Tristania* and Pteryperginae feed on *Elaeocarpus*. There are exceptions to this association with Myrtaceae: a pterygophorine which can be common on *Emex* and *Rumex* and species of Philomastiginae which feed on *Rubus*.

Pergidae occur only in Australasia and the New World. Little is known of the larval host plants of New World pergids but a broader range of families appears to be utilised. In the New World, pergid larvae have been recorded from Fagaceae, Juglandaceae, Vitaceae, Melastomataceae, Anacardiaceae and a number of cultivated plants such as guava (Myrtaceae) and potatoes (Solanaceae) (Smith 1990, 1993, 1995). Larvae of one Central American pergid belonging to the subfamily Perreyiinae have recently been discovered to be fungivorous (Smith 1995).

The subfamily Euryinae, to which *W. froggatti* belongs, also appears to depart from the association with living myrtaceous foliage. Larvae of the

euryine *Polyclonus atratus* feed on leaves of *Eucalyptus* and *Angophora* (Moore 1957) which is not exceptional; but it is unusual that these leaves, though still attached to branches, are dead or dying. Larvae of two other species of Euryinae are known to feed on dead leaves: Tillyard (1926) mentioned this habit for a species of *Diphamorphos* and a larva, presumed to be that of a species of *Clarissa* Kirby, has been observed feeding on dead leaves of *Ranunculus* (Ranunculaceae) in ground litter (Naumann in press).

Euryine larvae frequently are found on or close to the ground. *P. atratus* larvae shelter by day beneath leaves and plant litter under the branches of the host tree. *Diphamorphos* larvae have been found under bark (Tillyard 1926) and the presumed *Clarissa* larva lives on the ground among dead grass stems. Furthermore, a number of unidentified euryine larvae (see above) have been collected from leaf litter in eucalypt woodland and rainforest. These few records all suggest that euryine larvae are predominantly ground dwelling, feeding on dead plant material. The larva of *W. froggatti* is exceptional among euryines in feeding on live plant tissue; it feeds on a very low-growing plant but is not litter frequenting, except when seeking a pupation site.

The Euryinae are not the only group of Australian insects whose larvae appear to have abandoned life among the branches for one amongst the forest litter. This shift is paralleled in the Lepidoptera and in the Coleoptera. Lepidopterous larvae typically feed on green foliage and this is the case for many Oecophoridae. However, a large proportion of the Australian oecophorids feed as larvae only on dead leaves (Common 1990). Some feed on dead leaves still attached to trees, some apparently fall to the ground with dead leaves and branches, whilst some are found only in leaf litter. Many, if not most species of the largely Australian tortricid tribe Epitymbiini feed on dead myrtaceous leaves or leaf litter (M. Horak, pers. comm.). In the Coleoptera, the larvae of Chrysomelidae typically feed on living plant material. However, the larvae of Australian Cryptocephalini feed on dead leaves accumulating on the ground beneath eucalypts and acacias, which are the host plants for the adult beetles (Lawrence and Britton 1991).

The approximately 40 Australian Symphyta which do not belong to the Pergidae are distributed among the siricoid families (all of which feed within wood as phytophages or parasites), the Tenthredinidae (mostly introduced species and most associated with non-myrtaceous, woody hosts) and the Argidae (which feed variously on Portulacaceae, Cupressaceae and Proteacae). Thus larvae of no Australian Symphyta have previously been recorded from other than gymnosperms or angiosperms.

In contrast, in the Northern Hemisphere, ferns are important host plants for Symphyta (Benson 1950, Smith 1993). Ferns are the hosts for a few Tenthredininae and many Selandriinae (Tenthredinidae). Larvae of Blasticotomidae also feed on ferns. Most tenthredinid larvae feed externally

on the fronds. Larvae of *Rocalia* Takeuchi are unusual in that they feed on the spores of ferns. Larvae of *Heptamelus* Haliday (Tenthredinidae: Selandriinae) and all Blasticotomidae are borers and feed internally. The very earliest Symphyta, in Triassic and Jurassic times, probably fed on ferns and gymnosperms (Heitland and Pschorn-Walcher 1993), which would make the association of sawflies and ferns a very ancient one. In the absence of a phylogeny for the Pergidae we cannot infer whether the association between *W. froggatti* and *Marsilea* is primitive or derived within the family. However, the weight of host plant records for the Pergidae and the very specialised biology of *Marsilea* suggest that the association between *W. froggatti* and a fern is an apomorphy which has been derived within the family.

The observations above reveal several biological diffferences between *W. froggatti* and *P. atratus*, the only other euryine species for which the life cycle is known. *W. froggatti* females oviposit always into the host plant. Eggs of *P. atratus* are sometimes deposited on eucalypt leaves and sometimes on nearby grass. *W. froggatti* larvae feed by day and are not particularly gregarious, whereas larvae of *P. atratus* shelter together by day and feed at night or during dull days. The pupal cocoon of *P. atratus* is to be found either attached to vegetation or rocks, lying on the ground under plant debris, or in the upper 3 mm of soil. As far as is known *W. froggatti* pupates only in the soil.

The developmental period of *W. froggatti* (23 days from oviposition to adult emergence) is much less than that of *P. atratus* (10-26 weeks from egg to adult). There are six larval instars in *P atratus* and three in *W. froggatti.* Presumably this reflects the ephemeral nature of the food plant of *W. froggatti.* Water levels in the pools and streams in which *Marsilea* grow can fluctuate considerably: as water levels fall the fronds dry and die; as levels rise patches of *Marsilea* are inundated. Since *W. froggatti* larvae require fresh, green foliage, are slow moving and are not truly aquatic, any major fluctuations in water level would be fatal. *P. atratus* larvae, in contrast, are terrestrial and depend on dead leaves which are a much more enduring food source.

Acknowledgments

We thank Mr R. Giddins and Mr T. Vernon for assistance in the rearing of larvae and Drs N. Schiff (USDA), D. R. Smith (USDA) and M. Horak (CSIRO) for comments on an earlier draft of the manuscript. Figs 1-4 were drawn by Ms Anne Hastings.

References

BENSON, R.B. 1934. A classification of the sawflies of the family Pterygophoridae, with a revision of the Australian members of the subfamily Euryinae (Hymenoptera, Symphyta). *Transactions of the Royal Entomological Society of London* **82**: 461-478.

BENSON, R.B. 1950. An introduction to the natural history of British sawflies (Hymenoptera Symphyta). *Transactions for the Society for British Entomology* **10**: 45-142.

COMMON, I.F.B. 1990. *Moths of Australia.* Melbourne University Press, Carlton.

HEITLAND, W. and PSCHORN-WALCHER, H. 1993. Feeding strategies of sawflies, pp 93-118, *in:* Wagner, M.R. and Raffa, K.F. (eds) *Sawfly Life History Adaptions to Woody Plants.* Academic Press, San Diego.

LAWRENCE, J.F. and BRITTON, E.B. 1991. Coleoptera, pp 543-683, *in:* CSIRO (ed.) *The Insects of Australia.* 2nd edition. Melbourne University Press, Carlton.

LEACH, G.J. and OSBORNE, P.L. 1985. *Freshwater Plants of Papua New Guinea.* University of Papua New Guinea Press, Port Moresby.

MACDONALD, J. and OHMART, C.P. 1993. Life history strategies of Australian pergid sawflies and their interactions with host plants, pp 485-502,. *in:* Wagner, M.R. and Raffa, K.F. (eds) *Sawfly Life History Adaptions to Woody Plants.* Academic Press, San Diego.

MOORE, K.M. 1957. Observations on some Australian forest insects. *Proceedings of the Royal Zoological Society of New South Wales* **1955-1956**: 74-81.

NAUMANN, I.D. 1991. Hymenoptera, pp 916-1000, *in:* CSIRO (ed.) *The Insects of Australia.* 2nd edition. Melbourne University Press, Carlton.

NAUMANN, I.D. *in press.* A remarkable, new Australian sawfly with brachypterous, nocturnal or crepuscular females (Hymenoptera: Symphyta: Pergidae). *Journal of Natural History.*

ROHWER, S.A. 1922. Notes on sawflies of the tribe Euriini, with descriptions of two new species. *Bulletin of the Brooklyn Entomological Society* **17**: 91-94.

SMITH, D.R. 1978. Suborder Symphyta (Xyelidae, Pararchexyelidae, Parapamphiliidae, Xyelydidae, Karavitidae, Gigasiricidae, Sepulcidae, Pseudosiricidae, Anaxyelidae, Siricidae, Xiphydriidae, Paroryssidae, Xyelotomidae, Pergidae). *In*: van der Vecht, J. and Shenefelt, R.D. (eds) *Hymenopterorum Catalogus* **14**. W. Junk, The Hague.

SMITH, D.R. 1990. A synopsis of the sawflies (Hymenoptera, Symphyta) of America south of the United States: Pergidae. *Revista Brasileira de Entomologia* **34**: 7-200.

SMITH, D.R. 1993. Systematics, life history, and distribution of sawflies, pp 3-32, *in:* Wagner, M.R. and Raffa, K.F. (eds) *Sawfly Life History Adaptions to Woody Plants.* Academic Press, San Diego.

SMITH, D.R. 1995. The sawflies and woodwasps. *In* Hanson, P.E. and Gauld, I.D. *The Hymenoptera of Costa Rica.* Oxford University Press, Oxford.

SMITH, D.R. and MIDDLEKAUFF, W.W. 1987. Suborder Symphyta, pp 618-649, *in:* Stehr, F.W. *Immature Insects.* Kendall Hunt, Dubuque.

TILLYARD, R.J. 1926. *The Insects of Australia and New Zealand.* Angus and Robertson, Sydney.

WILLIAMS, K.A.W. 1980. *Native Plants of Queensland.* 2nd edition. K.A.W. Williams, North Ipswich.

AN ACCUMULATIVE BIBLIOGRAPHY OF AUSTRALIAN ENTOMOLOGY

Compiled by G. Daniels

ABLETT, E. and MATTICK, J.S.
1994 Conservation of invertebrate biodiversity: the role of ex situ preservation of genetic material. *Mem. Qd Mus.* 36: 3-6.

ALLEN, G.R. and PAPE, T.
1996 Description of female and biology of *Blaesoxipha ragg* Pape (Diptera: Sarcophagidae), a parasitoid of *Sciarasaga quadrata* Rentz (Orthoptera: Tettigoniidae) in Western Australia. *Aust. J. Ent.* 35: 147-151.

ANDERSEN, A.N.
1996 The ant fauna of Danggali Conservation Park in semi-arid South Australia: a comparison with Wyperfeld (Vic.) and Cape Arid (W.A.) National Parks. *Aust. J. Ent.* 35: 289-295.

ANDERSEN, A.N. and SPAIN, A.V.
1996 The ant fauna of the Bowen Basin, in the semi-arid tropics of Central Queensland (Hymenoptera: Formicidae). *Aust. J. Ent.* 35: 213-221.

BAEHR, M.
1995 Revision of *Philipis* (Coleoptera: Carabidae: Bembidinae), a genus of arboreal tachyine beetles from the rainforests of eastern Australia: taxonomy, phylogeny and biogeography. *Mem. Qd Mus.* 38: 315-381.

BARRACLOUGH, D.A. and ALLEN, G.R.
1996 Two new species of *Homotrixa* Villeneuve (Diptera: Tachinidae: Ormiini) from southwestern Australia, with data on biology and ecology. *Aust. J. Ent.* 35: 135-145.

BEATTIE, A.J.
1994 Invertebrates as economic resources. *Mem. Qd Mus.* 36: 7-11.

BRABY, M.F.
1996 A new species of *Nesolycaena* Waterhouse and Turner (Lepidoptera: Lycaenidae) from northeastern Australia. *Aust. J. Ent.* 35: 9-17.

BRAILOVSKY, H. and MONTEITH, G.B.
1996 A new species of *Pomponatius* Distant from Australia (Hemiptera: Heteroptera: Coreidae: Acanthocorini). *Mem. Qd Mus.* 39: 205-210.

BROWN, G.R.
1995 Revision of the Australian wasp genus *Macrothynnus* Turner (Hymenoptera: Tiphiidae: Thynninae). *Rec. West. Aust. Mus.* 17: 267-275.
1996 Females of the genus *Austromyzinum* (Hymenoptera: Tiphiidae: Myzininae). *Aust. J. Ent.* 35: 33-36.

BURWELL, C.J.
1996 Revision of the Australian genus *Microtropesa* Macquart (Diptera: Tachinidae: Tachinini). *Mem. Qd Mus.* 39: 211-226.

BUTCHER, R.J., CLUNIE, P.E. and YEN, A.L.
1994 The Victorian Flora and Fauna Guarantee Act: flagship legislation for invertebrate conservation. *Mem. Qd Mus.* 36: 13-19.

CAMPBELL, A.J. and BROWN, G.R.
1994 Distribution of parasitoids of scarab larvae in relation to remnant vegetation: a reliminary analysis. *Mem. Qd Mus.* 36: 27-32.

CARPENTER, J.M.
1996 Distributional checklist of species of the genus *Polistes* (Hymenoptera: Vespidae; Polistinae, Polistini). *Am. Mus. Novit.* 3188: 1-39.
1997 Generic classification of the Australian pollen wasps (Hymenoptera: Vespidae; Masarinae). *J. Kans. ent. Soc.* 69: 384-400.

CRANSTON, P.S.
1996 Immature stages of two unusual species of *Dicrotendipes* (Diptera: Chironomidae) from Australia. *Aust. J. Ent.* 35: 263-270.

CZECHURA, G.V.
1994 Is the public really interested in invertebrates? What the Queensland Museum Reference Centre enquiries from 1986-1993 tell us. *Mem. Qd Mus.* 36: 41-46.

ELDRIDGE, R.H.
1996 Revision of Australian *Glyptotermes* Froggatt (Isoptera: Kalotermitidae). *Aust. J. Ent.* 35: 165-176.

ERWIN, T.L.
1994 Arboreal beetles of tropical forests: the Xystosomi group, subtribe Xystosomina (Coleoptera: Carabidae: Bembidiini). Part I. Character analysis, taxonomy, and distribution. *Can. Ent.* 126: 549-666.

EXLEY, E.M.
1996 *Tumidihesma*, a new genus of Australian bees (Hymenoptera: Colletidae: Euryglossinae). *Aust. J. Ent.* 35: 253-255.

FLOATER, G.J.
1996 Life history comparisons of ground- and canopy-nesting populations of *Ochrogaster lunifer* Herrich-Schäffer (Lepidoptera: Thaumetopoeidae): evidence for two species? *Aust. J. Ent.* 35: 223-230.
1996 The Brooks-Dyar Rule and morphometrics of the processionary caterpillar *Ochrogaster lunifer* Herrich-Schäffer (Lepidoptera: Thaumetopoeidae). *Aust. J. Ent.* 35: 271-278.
1996 Estimating movement of the processionary caterpillar *Ochrogaster lunifer* Herrich-Schäffer (Lepidoptera: Thaumetopoeidae) between discrete resource patches. *Aust. J. Ent.* 35: 279-283.

GREENSLADE, P.J.M.
1994 Heritage listing of invertebrate sites in southeastern Australia. *Mem. Qd Mus.* 36: 67-76.

ENTOMOLOGICAL NOTICES

Items for insertion should be sent to the editor who reserves the right to alter, reject or charge for notices.

Suppliers of fine quality insect specimens for both the amateur and professional collector. Our latest catalogue contains over 1200 species of Papilionidae, Nymphalidae, Satyridae, Lycaenidae, Saturniidae, Scarabaeidae, Cerambycidae, Lucanidae and many other families from North and South America, Africa, Europe, Australia, Papua New Guinea, Solomons, Russia, etc. Many rare and hard to get species are available. We also supply preset material. The Insect Company, P.O. Box 618, Cooktown, Qld, 4871.

FOR SALE: Butterflies from all parts of the world. Papua New Guinea, Peru, Indonesia, Thailand, China, Africa, Brazil, Colombia, etc. Papilionidae inc. Parnassius, Delias, Charaxes etc. Free catalogue. David Hall, 6 Rule St, Cambridge Park, N.S.W., 2747. Ph. (047) 312 410.

FOR SALE. Butterflies from South America, Africa, etc. including many bred/ranched specimens. Serving Lepidopterists world-wide since 1976. Write for our 12-page illustrated catalogue: Transworld Butterfly Company, Apartado 6951, 10000 San Jose, Costa Rica, Central America.

ENTOMOLOGICAL BOOKS. Pemberley Books are specialist suppliers of entomological literature across the world. Send for our free catalogue which lists a wide range of antiquarian, second-hand and new natural history titles. Pemberley Books, Ian Johnson, 34 Melrose Close, Hayes, Middlesex, UB4 0AZ, England. Tel/Fax: +44 181 561 5494. E-mail: ij@pembooks.demon.co.uk

NOTES FOR AUTHORS

Manuscripts submitted for publication should, preferably, be type-written, double spaced and in triplicate. Refer to recent issues for layout and style.

All papers will be forwarded to two referees and the editor reserves the right to reject any paper considered unsuitable.

Papers longer than eight printed journal pages will normally not be accepted.

Papers will be accepted only if a minimum of 100 reprints is purchased. Manuscripts occupying less than one printed page may be accepted without charge if no reprints are required. Charges are as follows: cost per printed page $25 for 100 copies. Page charges may be reduced at the discretion of the Publications Committee.

Illustrations: Black and white photographs must be submitted at the size they are to appear in the journal. Line drawings should be about twice their required size.

Address papers to: The Editor
The Australian Entomologist
P.O. Box 537,
Indooroopilly, Queensland, 4068

THE AUSTRALIAN
Entomologist
Volume 24, Part 1, 25 July 1997

CONTENTS

ISSN 1320 6133